

detached from the background; while in the case here described the contrary occurs, not only in the picture, but in the objects themselves.

565.

That you ought, when representing objects above the eye and on one side--if you wish them to look detached from the wall--to show, between the shadow on the object and the shadow it casts a middle light, so that the body will appear to stand away from the wall.

On the lighting of white objects.

566.

HOW WHITE BODIES SHOULD BE REPRESENTED.

If you are representing a white body let it be surrounded by ample space, because as white has no colour of its own, it is tinged and altered in some degree by the colour of the objects surrounding it. If you see a woman dressed in white in the midst of a landscape, that side which is towards the sun is bright in colour, so much so that in some portions it will dazzle the eyes like the sun itself; and the side which is towards the atmosphere,--luminous through being interwoven with the sun's rays and penetrated by them--since the atmosphere itself is blue, that side of the woman's figure will

appear steeped in blue. If the surface of the ground about her be meadows and if she be standing between a field lighted up by the sun and the sun itself, you will see every portion of those folds which are towards the meadow tinged by the reflected rays with the colour of that meadow. Thus the white is transmuted into the colours of the luminous and of the non-luminous objects near it.

The methods of aerial (567--570).

567.

WHY FACES [SEEN] AT A DISTANCE LOOK DARK.

We see quite plainly that all the images of visible objects that lie before us, whether large or small, reach our sense by the minute aperture of the eye; and if, through so small a passage the image can pass of the vast extent of sky and earth, the face of a man--being by comparison with such large images almost nothing by reason of the distance which diminishes it,--fills up so little of the eye that it is indistinguishable. Having, also, to be transmitted from the surface to the sense through a dark medium, that is to say the crystalline lens which looks dark, this image, not being strong in colour becomes affected by this darkness on its passage, and on reaching the sense it appears dark; no other reason can in any way be assigned. If the point in the eye is black, it is because it is full of a transparent humour as clear as air and acts

like a perforation in a board; on looking into it it appears dark and the objects seen through the bright air and a dark one become confused in this darkness.

WHY A MAN SEEN AT A CERTAIN DISTANCE IS NOT RECOGNISABLE.

The perspective of diminution shows us that the farther away an object is the smaller it looks. If you look at a man at a distance from you of an arrow's flight, and hold the eye of a small needle close to your own eye, you can see through it several men whose images are transmitted to the eye and will all be comprised within the size of the needle's eye; hence, if the man who is at the distance of an arrow's flight can send his whole image to your eye, occupying only a small space in the needle's eye how can you [expect] in so small a figure to distinguish or see the nose or mouth or any detail of his person? and, not seeing these you cannot recognise the man, since these features, which he does not show, are what give men different aspects.

568.

THE REASON WHY SMALL FIGURES SHOULD NOT BE MADE FINISHED.

I say that the reason that objects appear diminished in size is because they are remote from the eye; this being the case it is evident that there must be a great extent of atmosphere between the

eye and the objects, and this air interferes with the distinctness of the forms of the object. Hence the minute details of these objects will be indistinguishable and unrecognisable. Therefore, O Painter, make your smaller figures merely indicated and not highly finished, otherwise you will produce effects the opposite to nature, your supreme guide. The object is small by reason of the great distance between it and the eye, this great distance is filled with air, that mass of air forms a dense body which intervenes and prevents the eye seeing the minute details of objects.

569.

Whenever a figure is placed at a considerable distance you lose first the distinctness of the smallest parts; while the larger parts are left to the last, losing all distinctness of detail and outline; and what remains is an oval or spherical figure with confused edges.

570.

OF PAINTING.

The density of a body of smoke looks white below the horizon while above the horizon it is dark, even if the smoke is in itself of a uniform colour, this uniformity will vary according to the variety in the ground on which it is seen.

IV.

OF PORTRAIT AND FIGURE PAINTING.

Of sketching figures and portraits (571-572).

571.

OF THE WAY TO LEARN TO COMPOSE FIGURES [IN GROUPS] IN HISTORICAL PICTURES.

When you have well learnt perspective and have by heart the parts and forms of objects, you must go about, and constantly, as you go, observe, note and consider the circumstances and behaviour of men in talking, quarrelling or laughing or fighting together: the action of the men themselves and the actions of the bystanders, who separate them or who look on. And take a note of them with slight strokes thus, in a little book which you should always carry with you. And it should be of tinted paper, that it may not be rubbed out, but change the old [when full] for a new one; since these things should not be rubbed out but preserved with great care; for the forms, and positions of objects are so infinite that the memory is incapable of retaining them, wherefore keep these [sketches] as your guides and masters.

[Footnote: Among Leonardo's numerous note books of pocket size not

one has coloured paper, so no sketches answering to this description can be pointed out. The fact that most of the notes are written in ink, militates against the supposition that they were made in the open air.]

572.

OF A METHOD OF KEEPING IN MIND THE FORM OF A FACE.

If you want to acquire facility for bearing in mind the expression of a face, first make yourself familiar with a variety of [forms of] several heads, eyes, noses, mouths, chins and cheeks and necks and shoulders: And to put a case: Noses are of 10 types: straight, bulbous, hollow, prominent above or below the middle, aquiline, regular, flat, round or pointed. These hold good as to profile. In full face they are of 11 types; these are equal thick in the middle, thin in the middle, with the tip thick and the root narrow, or narrow at the tip and wide at the root; with the nostrils wide or narrow, high or low, and the openings wide or hidden by the point; and you will find an equal variety in the other details; which things you must draw from nature and fix them in your mind. Or else, when you have to draw a face by heart, carry with you a little book in which you have noted such features; and when you have cast a glance at the face of the person you wish to draw, you can look, in private, which nose or mouth is most like, or there make a little mark to recognise it again at home. Of grotesque faces I need say

nothing, because they are kept in mind without difficulty.

The position of the head.

573.

HOW YOU SHOULD SET TO WORK TO DRAW A HEAD OF WHICH ALL THE PARTS

SHALL AGREE WITH THE POSITION GIVEN TO IT.

To draw a head in which the features shall agree with the turn and bend of the head, pursue this method. You know that the eyes, eyebrows, nostrils, corners of the mouth, and sides of the chin, the jaws, cheeks, ears and all the parts of a face are squarely and straightly set upon the face.

[Footnote: Compare the drawings and the text belonging to them on Pl. IX. (No. 315), Pl. X (No. 316), Pl. XL (No. 318) and Pl. XII. (No. 319).]

Therefore when you have sketched the face draw lines passing from one corner of the eye to the other; and so for the placing of each feature; and after having drawn the ends of the lines beyond the two sides of the face, look if the spaces inside the same parallel lines on the right and on the left are equal [12]. But be sure to remember to make these lines tend to the point of sight.

[Footnote: See Pl. XXXI, No. 4, the slight sketch on the left hand side. The text of this passage is written by the side of it. In this sketch the lines seem intentionally incorrect and converging to the right (compare I. 12) instead of parallel. Compare too with this text the drawing in red chalk from Windsor Castle which is reproduced on Pl. XL, No. 2.]

Of the light on the face (574-576).

574.

HOW TO KNOW WHICH SIDE OF AN OBJECT IS TO BE MORE OR LESS LUMINOUS THAN THE OTHER.

Let f be the light, the head will be the object illuminated by it and that side of the head on which the rays fall most directly will be the most highly lighted, and those parts on which the rays fall most aslant will be less lighted. The light falls as a blow might, since a blow which falls perpendicularly falls with the greatest force, and when it falls obliquely it is less forcible than the former in proportion to the width of the angle. Exempli gratia if you throw a ball at a wall of which the extremities are equally far from you the blow will fall straight, and if you throw the ball at the wall when standing at one end of it the ball will hit it

obliquely and the blow will not tell.

[Footnote: See Pl. XXXI. No. 4; the sketch on the right hand side.]

575.

THE PROOF AND REASON WHY AMONG THE ILLUMINATED PARTS CERTAIN PORTIONS ARE IN HIGHER LIGHT THAN OTHERS.

Since it is proved that every definite light is, or seems to be, derived from one single point the side illuminated by it will have its highest light on the portion where the line of radiance falls perpendicularly; as is shown above in the lines a g, and also in a h and in l a; and that portion of the illuminated side will be least luminous, where the line of incidence strikes it between two more dissimilar angles, as is seen at b c d. And by this means you may also know which parts are deprived of light as is seen at m k.

Where the angles made by the lines of incidence are most equal there will be the highest light, and where they are most unequal it will be darkest.

I will make further mention of the reason of reflections.

[Footnote: See Pl. XXXII. The text, here given complete, is on the right hand side. The small circles above the beginning of lines 5

and 11 as well as the circle above the text on Pl. XXXI, are in a paler ink and evidently added by a later hand in order to distinguish the text as belonging to the Libro di Pittura (see Prolegomena. No. 12, p. 3). The text on the left hand side of this page is given as Nos. 577 and 137.]

576.

Where the shadow should be on the face.

General suggestions for historical pictures (577-581).

577.

When you compose a historical picture take two points, one the point of sight, and the other the source of light; and make this as distant as possible.

578.

Historical pictures ought not to be crowded and confused with too many figures.

579.

PRECEPTS IN PAINTING.

Let your sketches of historical pictures be swift and the working out of the limbs not be carried too far, but limited to the position of the limbs, which you can afterwards finish as you please and at your leisure.

[Footnote: See Pl. XXXVIII, No. 2. The pen and ink drawing given there as No. 3 may also be compared with this passage. It is in the Windsor collection where it is numbered 101.]

580.

The sorest misfortune is when your views are in advance of your work.

581.

Of composing historical pictures. Of not considering the limbs in the figures in historical pictures; as many do who, in the wish to represent the whole of a figure, spoil their compositions. And when you place one figure behind another take care to draw the whole of it so that the limbs which come in front of the nearer figures may stand out in their natural size and place.

How to represent the differences of age and sex (582-583).

582.

How the ages of man should be depicted: that is, Infancy, Childhood, Youth, Manhood, Old age, Decrepitude.

[Footnote: No answer is here given to this question, in the original MS.]

583.

Old men ought to be represented with slow and heavy movements, their legs bent at the knees, when they stand still, and their feet placed parallel and apart; bending low with the head leaning forward, and their arms but little extended.

Women must be represented in modest attitudes, their legs close together, their arms closely folded, their heads inclined and somewhat on one side.

Old women should be represented with eager, swift and furious gestures, like infernal furies; but the action should be more violent in their arms and head than in their legs.

Little children, with lively and contorted movements when sitting, and, when standing still, in shy and timid attitudes.

[Footnote: bracci raccolte. Compare Pl. XXXIII. This drawing, in silver point on yellowish tinted paper, the lights heightened with white, represents two female hands laid together in a lap. Above is a third finished study of a right hand, apparently holding a veil from the head across the bosom. This drawing evidently dates from before 1500 and was very probably done at Florence, perhaps as a preparatory study for some picture. The type of hand with its slender thin forms is more like the style of the Vierge aux Rochers in the Louvre than any later works--as the Mona Lisa for instance.]

Of representing the emotions.

584.

THAT A FIGURE IS NOT ADMIRABLE UNLESS IT EXPRESSES BY ITS ACTION
THE
PASSION OF ITS SENTIMENT.

That figure is most admirable which by its actions best expresses
the passion that animates it.

HOW AN ANGRY MAN IS TO BE FIGURED.

You must make an angry person holding someone by the hair, wrenching
his head against the ground, and with one knee on his ribs; his

right arm and fist raised on high. His hair must be thrown up, his brow downcast and knit, his teeth clenched and the two corners of his mouth grimly set; his neck swelled and bent forward as he leans over his foe, and full of furrows.

HOW TO REPRESENT A MAN IN DESPAIR.

You must show a man in despair with a knife, having already torn open his garments, and with one hand tearing open the wound. And make him standing on his feet and his legs somewhat bent and his whole person leaning towards the earth; his hair flying in disorder.

Of representing imaginary animals.

585.

HOW YOU SHOULD MAKE AN IMAGINARY ANIMAL LOOK NATURAL.

You know that you cannot invent animals without limbs, each of which, in itself, must resemble those of some other animal. Hence if you wish to make an animal, imagined by you, appear natural--let us say a Dragon, take for its head that of a mastiff or hound, with the eyes of a cat, the ears of a porcupine, the nose of a greyhound, the brow of a lion, the temples of an old cock, the neck of a water tortoise.

[Footnote: The sketch here inserted of two men on horseback fighting a dragon is the facsimile of a pen and ink drawing belonging to BARON EDMOND DE ROTHSCHILD of Paris.]

The selection of forms.

586.

OF THE DELUSIONS WHICH ARISE IN JUDGING OF THE LIMBS.

A painter who has clumsy hands will paint similar hands in his works, and the same will occur with any limb, unless long study has taught him to avoid it. Therefore, O Painter, look carefully what part is most ill-favoured in your own person and take particular pains to correct it in your studies. For if you are coarse, your figures will seem the same and devoid of charm; and it is the same with any part that may be good or poor in yourself; it will be shown in some degree in your figures.

587.

OF THE SELECTION OF BEAUTIFUL FACES.

It seems to me to be no small charm in a painter when he gives his figures a pleasing air, and this grace, if he have it not by nature, he may acquire by incidental study in this way: Look about you and

take the best parts of many beautiful faces, of which the beauty is confirmed rather by public fame than by your own judgment; for you might be mistaken and choose faces which have some resemblance to your own. For it would seem that such resemblances often please us; and if you should be ugly, you would select faces that were not beautiful and you would then make ugly faces, as many painters do. For often a master's work resembles himself. So select beauties as I tell you, and fix them in your mind.

588.

Of the limbs, which ought to be carefully selected, and of all the other parts with regard to painting.

589.

When selecting figures you should choose slender ones rather than lean and wooden ones.

590.

OF THE MUSCLES OF ANIMALS.

The hollow spaces interposed between the muscles must not be of such a character as that the skin should seem to cover two sticks laid side by side like c, nor should they seem like two sticks somewhat

remote from such contact so that the skin hangs in an empty loose curve as at f; but it should be like i, laid over the spongy fat that lies in the angles as the angle n m o; which angle is formed by the contact of the ends of the muscles and as the skin cannot fold down into such an angle, nature has filled up such angles with a small quantity of spongy and, as I may say, vesicular fat, with minute bladders [in it] full of air, which is condensed or rarefied in them according to the increase or the diminution of the substance of the muscles; in which latter case the concavity i always has a larger curve than the muscle.

591.

OF UNDULATING MOVEMENTS AND EQUIPOISE IN FIGURES AND OTHER ANIMALS.

When representing a human figure or some graceful animal, be careful to avoid a wooden stiffness; that is to say make them move with equipoise and balance so as not to look like a piece of wood; but those you want to represent as strong you must not make so, excepting in the turn of the head.

How to pose figures.

592.

OF GRACE IN THE LIMBS.

The limbs should be adapted to the body with grace and with reference to the effect that you wish the figure to produce. And if you wish to produce a figure that shall of itself look light and graceful you must make the limbs elegant and extended, and without too much display of the muscles; and those few that are needed for your purpose you must indicate softly, that is, not very prominent and without strong shadows; the limbs, and particularly the arms easy; that is, none of the limbs should be in a straight line with the adjoining parts. And if the hips, which are the pole of a man, are by reason of his position, placed so, that the right is higher than the left, make the point of the higher shoulder in a perpendicular line above the highest prominence of the hip, and let this right shoulder be lower than the left. Let the pit of the throat always be over the centre of the joint of the foot on which the man is leaning. The leg which is free should have the knee lower than the other, and near the other leg. The positions of the head and arms are endless and I shall therefore not enlarge on any rules for them. Still, let them be easy and pleasing, with various turns and twists, and the joints gracefully bent, that they may not look like pieces of wood.

Of appropriate gestures (593-600).

593.

A picture or representation of human figures, ought to be done in such a way as that the spectator may easily recognise, by means of their attitudes, the purpose in their minds. Thus, if you have to represent a man of noble character in the act of speaking, let his gestures be such as naturally accompany good words; and, in the same way, if you wish to depict a man of a brutal nature, give him fierce movements; as with his arms flung out towards the listener, and his head and breast thrust forward beyond his feet, as if following the speaker's hands. Thus it is with a deaf and dumb person who, when he sees two men in conversation--although he is deprived of hearing--can nevertheless understand, from the attitudes and gestures of the speakers, the nature of their discussion. I once saw in Florence a man who had become deaf who, when you spoke very loud did not understand you, but if you spoke gently and without making any sound, understood merely from the movement of the lips. Now perhaps you will say that the lips of a man who speaks loudly do not move like those of one speaking softly, and that if they were to move them alike they would be alike understood. As to this argument, I leave the decision to experiment; make a man speak to you gently and note [the motion of] his lips.

[Footnote: The first ten lines of this text have already been published, but with a slightly different reading by Dr. M. JORDAN: Das Malerbuch Leonardo da Vinci's p. 86.]

594.

OF REPRESENTING A MAN SPEAKING TO A MULTITUDE.

When you wish to represent a man speaking to a number of people, consider the matter of which he has to treat and adapt his action to the subject. Thus, if he speaks persuasively, let his action be appropriate to it. If the matter in hand be to set forth an argument, let the speaker, with the fingers of the right hand hold one finger of the left hand, having the two smaller ones closed; and his face alert, and turned towards the people with mouth a little open, to look as though he spoke; and if he is sitting let him appear as though about to rise, with his head forward. If you represent him standing make him leaning slightly forward with body and head towards the people. These you must represent as silent and attentive, all looking at the orator's face with gestures of admiration; and make some old men in astonishment at the things they hear, with the corners of their mouths pulled down and drawn in, their cheeks full of furrows, and their eyebrows raised, and wrinkling the forehead where they meet. Again, some sitting with their fingers clasped holding their weary knees. Again, some bent old man, with one knee crossed over the other; on which let him hold his hand with his other elbow resting in it and the hand supporting his bearded chin.

[Footnote: The sketches introduced here are a facsimile of a pen and

ink drawing in the Louvre which Herr CARL BRUN considers as studies for the Last Supper in the church of Santa Maria delle Grazie (see Leonardo da Vinci, LXI, pp. 21, 27 and 28 in DOHME'S Kunst und Künstler, Leipzig, Seemann). I shall not here enter into any discussion of this suggestion; but as a justification for introducing the drawing in this place, I may point out that some of the figures illustrate this passage as perfectly as though they had been drawn for that express purpose. I have discussed the probability of a connection between this sketch and the picture of the Last Supper on p. 335. The original drawing is $27 \frac{3}{4}$ centimetres wide by 21 high.--The drawing in silver point on reddish paper given on Pl. LII. No. 1--the original at Windsor Castle--may also serve to illustrate the subject of appropriate gestures, treated in Nos. 593 and 594.]

595.

OF THE DISPOSITION OF LIMBS.

As regards the disposition of limbs in movement you will have to consider that when you wish to represent a man who, by some chance, has to turn backwards or to one side, you must not make him move his feet and all his limbs towards the side to which he turns his head.

Rather must you make the action proceed by degrees and through the different joints; that is, those of the foot, the knee and the hip and the neck. And if you set him on the right leg, you must make the

left knee bend inwards, and let his foot be slightly raised on the outside, and the left shoulder be somewhat lower than the right, while the nape of the neck is in a line directly over the outer angle of the left foot. And the left shoulder will be in a perpendicular line above the toes of the right foot. And always set your figures so that the side to which the head turns is not the side to which the breast faces, since nature for our convenience has made us with a neck which bends with ease in many directions, the eye wishing to turn to various points, the different joints. And if at any time you make a man sitting with his arms at work on something which is sideways to him, make the upper part of his body turn upon the hips.

[Footnote: Compare Pl. VII, No. 5. The original drawing at Windsor Castle is numbered 104.]

596.

When you draw the nude always sketch the whole figure and then finish those limbs which seem to you the best, but make them act with the other limbs; otherwise you will get a habit of never putting the limbs well together on the body.

Never make the head turn the same way as the torso, nor the arm and leg move together on the same side. And if the face is turned to the right shoulder, make all the parts lower on the left side than on

the right; and when you turn the body with the breast outwards, if the head turns to the left side make the parts on the right side higher than those on the left.

[Footnote: In the original MS. a much defaced sketch is to be seen by the side of the second part of this chapter; its faded condition has rendered reproduction impossible. In M. RAVAISSON'S facsimile the outlines of the head have probably been touched up. This passage however is fitly illustrated by the drawings on Pl. XXI.]

597.

OF PAINTING.

Of the nature of movements in man. Do not repeat the same gestures in the limbs of men unless you are compelled by the necessity of their action, as is shown in a b.

[Footnote: See Pl. V, where part of the text is also reproduced. The effaced figure to the extreme left has evidently been cancelled by Leonardo himself as unsatisfactory.]

598.

The motions of men must be such as suggest their dignity or their baseness.

599.

OF PAINTING.

Make your work carry out your purpose and meaning. That is when you draw a figure consider well who it is and what you wish it to be doing.

OF PAINTING.

With regard to any action which you give in a picture to an old man or to a young one, you must make it more energetic in the young man in proportion as he is stronger than the old one; and in the same way with a young man and an infant.

600.

OF SETTING ON THE LIMBS.

The limbs which are used for labour must be muscular and those which are not much used you must make without muscles and softly rounded.

OF THE ACTION OF THE FIGURES.

Represent your figures in such action as may be fitted to express

what purpose is in the mind of each; otherwise your art will not be admirable.

V.

SUGGESTIONS FOR COMPOSITIONS.

Of painting battle pieces (601-603).

601.

OF THE WAY OF REPRESENTING A BATTLE.

First you must represent the smoke of artillery mingling in the air with the dust and tossed up by the movement of horses and the combatants. And this mixture you must express thus: The dust, being a thing of earth, has weight; and although from its fineness it is easily tossed up and mingles with the air, it nevertheless readily falls again. It is the finest part that rises highest; hence that part will be least seen and will look almost of the same colour as the air. The higher the smoke mixed with the dust-laden air rises towards a certain level, the more it will look like a dark cloud; and it will be seen that at the top, where the smoke is more separate from the dust, the smoke will assume a bluish tinge and the dust will tend to its colour. This mixture of air, smoke and dust will look much lighter on the side whence the light comes than on

the opposite side. The more the combatants are in this turmoil the less will they be seen, and the less contrast will there be in their lights and shadows. Their faces and figures and their appearance, and the musketeers as well as those near them you must make of a glowing red. And this glow will diminish in proportion as it is remote from its cause.

The figures which are between you and the light, if they be at a distance, will appear dark on a light background, and the lower part of their legs near the ground will be least visible, because there the dust is coarsest and densest [19]. And if you introduce horses galloping outside the crowd, make the little clouds of dust distant from each other in proportion to the strides made by the horses; and the clouds which are furthest removed from the horses, should be least visible; make them high and spreading and thin, and the nearer ones will be more conspicuous and smaller and denser [23]. The air must be full of arrows in every direction, some shooting upwards, some falling, some flying level. The balls from the guns must have a train of smoke following their flight. The figures in the foreground you must make with dust on the hair and eyebrows and on other flat places likely to retain it. The conquerors you will make rushing onwards with their hair and other light things flying on the wind, with their brows bent down,

[Footnote: 19--23. Compare 608. 57--75.]

602.

and with the opposite limbs thrust forward; that is where a man puts forward the right foot the left arm must be advanced. And if you make any one fallen, you must show the place where he has slipped and been dragged along the dust into blood stained mire; and in the half-liquid earth arround show the print of the tramping of men and horses who have passed that way. Make also a horse dragging the dead body of his master, and leaving behind him, in the dust and mud, the track where the body was dragged along. You must make the conquered and beaten pale, their brows raised and knit, and the skin above their brows furrowed with pain, the sides of the nose with wrinkles going in an arch from the nostrils to the eyes, and make the nostrils drawn up--which is the cause of the lines of which I speak--, and the lips arched upwards and discovering the upper teeth; and the teeth apart as with crying out and lamentation. And make some one shielding his terrified eyes with one hand, the palm towards the enemy, while the other rests on the ground to support his half raised body. Others represent shouting with their mouths open, and running away. You must scatter arms of all sorts among the feet of the combatants, as broken shields, lances, broken swords and other such objects. And you must make the dead partly or entirely covered with dust, which is changed into crimson mire where it has mingled with the flowing blood whose colour shows it issuing in a sinuous stream from the corpse. Others must be represented in the agonies of death grinding their teeth, rolling their eyes, with

their fists clenched against their bodies and their legs contorted. Some might be shown disarmed and beaten down by the enemy, turning upon the foe, with teeth and nails, to take an inhuman and bitter revenge. You might see some riderless horse rushing among the enemy, with his mane flying in the wind, and doing no little mischief with his heels. Some maimed warrior may be seen fallen to the earth, covering himself with his shield, while the enemy, bending over him, tries to deal him a deathstroke. There again might be seen a number of men fallen in a heap over a dead horse. You would see some of the victors leaving the fight and issuing from the crowd, rubbing their eyes and cheeks with both hands to clean them of the dirt made by their watering eyes smarting from the dust and smoke. The reserves may be seen standing, hopeful but cautious; with watchful eyes, shading them with their hands and gazing through the dense and murky confusion, attentive to the commands of their captain. The captain himself, his staff raised, hurries towards these auxiliaries, pointing to the spot where they are most needed. And there may be a river into which horses are galloping, churning up the water all round them into turbulent waves of foam and water, tossed into the air and among the legs and bodies of the horses. And there must not be a level spot that is not trampled with gore.

603.

OF LIGHTING THE LOWER PARTS OF BODIES CLOSE TOGETHER, AS OF MEN
IN

BATTLE.

As to men and horses represented in battle, their different parts will be dark in proportion as they are nearer to the ground on which they stand. And this is proved by the sides of wells which grow darker in proportion to their depth, the reason of which is that the deepest part of the well sees and receives a smaller amount of the luminous atmosphere than any other part.

And the pavement, if it be of the same colour as the legs of these said men and horses, will always be more lighted and at a more direct angle than the said legs &c.

604.

OF THE WAY TO REPRESENT A NIGHT [SCENE].

That which is entirely bereft of light is all darkness; given a night under these conditions and that you want to represent a night scene,--arrange that there shall be a great fire, then the objects which are nearest to this fire will be most tinged with its colour; for those objects which are nearest to a coloured light participate most in its nature; as therefore you give the fire a red colour, you must make all the objects illuminated by it ruddy; while those which are farther from the fire are more tinted by the black hue of night. The figures which are seen against the fire look dark in the glare

of the firelight because that side of the objects which you see is tinged by the darkness of the night and not by the fire; and those who stand at the side are half dark and half red; while those who are visible beyond the edges of the flame will be fully lighted by the ruddy glow against a black background. As to their gestures, make those which are near it screen themselves with their hands and cloaks as a defence against the intense heat, and with their faces turned away as if about to retire. Of those farther off represent several as raising their hands to screen their eyes, hurt by the intolerable glare.

Of depicting a tempest (605. 606).

605.

Describe a wind on land and at sea. Describe a storm of rain.

606.

HOW TO REPRESENT A TEMPEST.

If you wish to represent a tempest consider and arrange well its effects as seen, when the wind, blowing over the face of the sea and earth, removes and carries with it such things as are not fixed to the general mass. And to represent the storm accurately you must first show the clouds scattered and torn, and flying with the wind,

accompanied by clouds of sand blown up from the sea shore, and boughs and leaves swept along by the strength and fury of the blast and scattered with other light objects through the air. Trees and plants must be bent to the ground, almost as if they would follow the course of the gale, with their branches twisted out of their natural growth and their leaves tossed and turned about [Footnote 11: See Pl. XL, No. 2.]. Of the men who are there some must have fallen to the ground and be entangled in their garments, and hardly to be recognized for the dust, while those who remain standing may be behind some tree, with their arms round it that the wind may not tear them away; others with their hands over their eyes for the dust, bending to the ground with their clothes and hair streaming in the wind. [Footnote 15: See Pl. XXXIV, the right hand lower sketch.] Let the sea be rough and tempestuous and full of foam whirled among the lofty waves, while the wind flings the lighter spray through the stormy air, till it resembles a dense and swathing mist. Of the ships that are therein some should be shown with rent sails and the tatters fluttering through the air, with ropes broken and masts split and fallen. And the ship itself lying in the trough of the sea and wrecked by the fury of the waves with the men shrieking and clinging to the fragments of the vessel. Make the clouds driven by the impetuosity of the wind and flung against the lofty mountain tops, and wreathed and torn like waves beating upon rocks; the air itself terrible from the deep darkness caused by the dust and fog and heavy clouds.

Of representing the deluge (607-609).

607.

TO REPRESENT THE DELUGE.

The air was darkened by the heavy rain whose oblique descent driven aslant by the rush of the winds, flew in drifts through the air not otherwise than as we see dust, varied only by the straight lines of the heavy drops of falling water. But it was tinged with the colour of the fire kindled by the thunder-bolts by which the clouds were rent and shattered; and whose flashes revealed the broad waters of the inundated valleys, above which was seen the verdure of the bending tree tops. Neptune will be seen in the midst of the water with his trident, and [15] let AEolus with his winds be shown entangling the trees floating uprooted, and whirling in the huge waves. The horizon and the whole hemisphere were obscure, but lurid from the flashes of the incessant lightning. Men and birds might be seen crowded on the tall trees which remained uncovered by the swelling waters, originators of the mountains which surround the great abysses [Footnote 23: Compare Vol. II. No. 979.].

608.

OF THE DELUGE AND HOW TO REPRESENT IT IN A PICTURE.

Let the dark and gloomy air be seen buffeted by the rush of contrary winds and dense from the continued rain mingled with hail and bearing hither and thither an infinite number of branches torn from the trees and mixed with numberless leaves. All round may be seen venerable trees, uprooted and stripped by the fury of the winds; and fragments of mountains, already scoured bare by the torrents, falling into those torrents and choking their valleys till the swollen rivers overflow and submerge the wide lowlands and their inhabitants. Again, you might have seen on many of the hill-tops terrified animals of different kinds, collected together and subdued to tameness, in company with men and women who had fled there with their children. The waters which covered the fields, with their waves were in great part strewn with tables, bedsteads, boats and various other contrivances made from necessity and the fear of death, on which were men and women with their children amid sounds of lamentation and weeping, terrified by the fury of the winds which with their tempestuous violence rolled the waters under and over and about the bodies of the drowned. Nor was there any object lighter than the water which was not covered with a variety of animals which, having come to a truce, stood together in a frightened crowd--among them wolves, foxes, snakes and others--fleing from death. And all the waters dashing on their shores seemed to be battling them with the blows of drowned bodies, blows which killed those in whom any life remained [19]. You might have seen assemblages of men who, with weapons in their hands, defended the small spots that remained to them against lions, wolves and beasts

of prey who sought safety there. Ah! what dreadful noises were heard in the air rent by the fury of the thunder and the lightnings it flashed forth, which darted from the clouds dealing ruin and striking all that opposed its course. Ah! how many you might have seen closing their ears with their hands to shut out the tremendous sounds made in the darkened air by the raging of the winds mingling with the rain, the thunders of heaven and the fury of the thunder-bolts. Others were not content with shutting their eyes, but laid their hands one over the other to cover them the closer that they might not see the cruel slaughter of the human race by the wrath of God. Ah! how many laments! and how many in their terror flung themselves from the rocks! Huge branches of great oaks loaded with men were seen borne through the air by the impetuous fury of the winds. How many were the boats upset, some entire, and some broken in pieces, on the top of people labouring to escape with gestures and actions of grief foretelling a fearful death. Others, with desperate act, took their own lives, hopeless of being able to endure such suffering; and of these, some flung themselves from lofty rocks, others strangled themselves with their own hands, other seized their own children and violently slew them at a blow; some wounded and killed themselves with their own weapons; others, falling on their knees recommended themselves to God. Ah! how many mothers wept over their drowned sons, holding them upon their knees, with arms raised spread out towards heaven and with words and various threatening gestures, upbraiding the wrath of the gods. Others with clasped hands and fingers clenched gnawed them and

devoured them till they bled, crouching with their breast down on their knees in their intense and unbearable anguish. Herds of animals were to be seen, such as horses, oxen, goats and swine already environed by the waters and left isolated on the high peaks of the mountains, huddled together, those in the middle climbing to the top and treading on the others, and fighting fiercely themselves; and many would die for lack of food. Already had the birds begun to settle on men and on other animals, finding no land uncovered which was not occupied by living beings, and already had famine, the minister of death, taken the lives of the greater number of the animals, when the dead bodies, now fermented, were leaving the depth of the waters and were rising to the top. Among the buffeting waves, where they were beating one against the other, and, like as balls full of air, rebounded from the point of concussion, these found a resting place on the bodies of the dead. And above these judgements, the air was seen covered with dark clouds, riven by the forked flashes of the raging bolts of heaven, lighting up on all sides the depth of the gloom.

The motion of the air is seen by the motion of the dust thrown up by the horse's running and this motion is as swift in again filling up the vacuum left in the air which enclosed the horse, as he is rapid in passing away from the air.

Perhaps it will seem to you that you may reproach me with having represented the currents made through the air by the motion of the

wind notwithstanding that the wind itself is not visible in the air.
To this I must answer that it is not the motion of the wind but only
the motion of the things carried along by it which is seen in the
air.

THE DIVISIONS. [Footnote 76: These observations, added at the bottom
of the page containing the full description of the doluge seem to
indicate that it was Leonardo's intention to elaborate the subject
still farther in a separate treatise.]

Darkness, wind, tempest at sea, floods of water, forests on fire,
rain, bolts from heaven, earthquakes and ruins of mountains,
overthrow of cities [Footnote 81: Spianamenti di citta (overthrow
of cities). A considerable number of drawings in black chalk, at
Windsor, illustrate this catastrophe. Most of them are much rubbed;
one of the least injured is reproduced at Pl. XXXIX. Compare also
the pen and ink sketch Pl. XXXVI.]

Whirlwinds which carry water [spouts] branches of trees, and men
through the air.

Boughs stripped off by the winds, mingling by the meeting of the
winds, with people upon them.

Broken trees loaded with people.

Ships broken to pieces, beaten on rocks.

Flocks of sheep. Hail stones, thunderbolts, whirlwinds.

People on trees which are unable to support them; trees and rocks, towers and hills covered with people, boats, tables, troughs, and other means of floating. Hills covered with men, women and animals; and lightning from the clouds illuminating every thing.

[Footnote: This chapter, which, with the next one, is written on a loose sheet, seems to be the passage to which one of the compilers of the Vatican copy alluded when he wrote on the margin of fol. 36: "Qua mi ricordo della mirabile discriptione del Diluuio dello autore." It is scarcely necessary to point out that these chapters are among those which have never before been published. The description in No. 607 may be regarded as a preliminary sketch for this one. As the MS. G. (in which it is to be found) must be attributed to the period of about 1515 we may deduce from it the approximate date of the drawings on Pl. XXXIV, XXXV, Nos. 2 and 3, XXXVI and XXXVII, since they obviously belong to this text. The drawings No. 2 on Pl. XXXV are, in the original, side by side with the text of No. 608; lines 57 to 76 are shown in the facsimile. In the drawing in Indian ink given on Pl. XXXIV we see Wind-gods in the sky, corresponding to the allusion to Aeolus in No. 607 1.

15.-Plates XXXVI and XXXVII form one sheet in the original. The texts reproduced on these Plates have however no connection with the

sketches, excepting the sketches of clouds on the right hand side. These texts are given as No. 477. The group of small figures on Pl. XXXVII, to the left, seems to be intended for a 'congregatione d'uomini.' See No. 608, l. 19.]

609.

DESCRIPTION OF THE DELUGE.

Let there be first represented the summit of a rugged mountain with valleys surrounding its base, and on its sides let the surface of the soil be seen to slide, together with the small roots of the bushes, denuding great portions of the surrounding rocks. And descending ruinous from these precipices in its boisterous course, let it dash along and lay bare the twisted and gnarled roots of large trees overthrowing their roots upwards; and let the mountains, as they are scoured bare, discover the profound fissures made in them by ancient earthquakes. The base of the mountains may be in great part clothed and covered with ruins of shrubs, hurled down from the sides of their lofty peaks, which will be mixed with mud, roots, boughs of trees, with all sorts of leaves thrust in with the mud and earth and stones. And into the depth of some valley may have fallen the fragments of a mountain forming a shore to the swollen waters of its river; which, having already burst its banks, will rush on in monstrous waves; and the greatest will strike upon and destroy the walls of the cities and farmhouses in the valley [14].

Then the ruins of the high buildings in these cities will throw up a great dust, rising up in shape like smoke or wreathed clouds against the falling rain; But the swollen waters will sweep round the pool which contains them striking in eddying whirlpools against the different obstacles, and leaping into the air in muddy foam; then, falling back, the beaten water will again be dashed into the air. And the whirling waves which fly from the place of concussion, and whose impetus moves them across other eddies going in a contrary direction, after their recoil will be tossed up into the air but without dashing off from the surface. Where the water issues from the pool the spent waves will be seen spreading out towards the outlet; and there falling or pouring through the air and gaining weight and impetus they will strike on the water below piercing it and rushing furiously to reach its depth; from which being thrown back it returns to the surface of the lake, carrying up the air that was submerged with it; and this remains at the outlet in foam mingled with logs of wood and other matters lighter than water. Round these again are formed the beginnings of waves which increase the more in circumference as they acquire more movement; and this movement rises less high in proportion as they acquire a broader base and thus they are less conspicuous as they die away. But if these waves rebound from various objects they then return in direct opposition to the others following them, observing the same law of increase in their curve as they have already acquired in the movement they started with. The rain, as it falls from the clouds is of the same colour as those clouds, that is in its shaded side;

unless indeed the sun's rays should break through them; in that case the rain will appear less dark than the clouds. And if the heavy masses of ruin of large mountains or of other grand buildings fall into the vast pools of water, a great quantity will be flung into the air and its movement will be in a contrary direction to that of the object which struck the water; that is to say: The angle of reflection will be equal to the angle of incidence. Of the objects carried down by the current, those which are heaviest or rather largest in mass will keep farthest from the two opposite shores. The water in the eddies revolves more swiftly in proportion as it is nearer to their centre. The crests of the waves of the sea tumble to their bases falling with friction on the bubbles of their sides; and this friction grinds the falling water into minute particles and this being converted into a dense mist, mingles with the gale in the manner of curling smoke and wreathing clouds, and at last it, rises into the air and is converted into clouds. But the rain which falls through the atmosphere being driven and tossed by the winds becomes rarer or denser according to the rarity or density of the winds that buffet it, and thus there is generated in the atmosphere a moisture formed of the transparent particles of the rain which is near to the eye of the spectator. The waves of the sea which break on the slope of the mountains which bound it, will foam from the velocity with which they fall against these hills; in rushing back they will meet the next wave as it comes and and after a loud noise return in a great flood to the sea whence they came. Let great numbers of inhabitants--men and animals of all kinds--be seen driven [54] by

the rising of the deluge to the peaks of the mountains in the midst of the waters aforesaid.

The wave of the sea at Piombino is all foaming water. [Footnote 55. 56: These two lines are written below the bottom sketch on Pl. XXXV, 3. The MS. Leic. being written about the year 1510 or later, it does not seem to me to follow that the sketches must have been made at Piombino, where Leonardo was in the year 1502 and possibly returned there subsequently (see Vol. II. Topographical notes).]

Of the water which leaps up from the spot where great masses fall on its surface. Of the winds of Piombino at Piombino. Eddies of wind and rain with boughs and shrubs mixed in the air. Emptying the boats of the rain water.

[Footnote: The sketches on Pl. XXXV 3 stand by the side of lines 14 to 54.]

Of depicting natural phenomena (610. 611).

610.

The tremendous fury of the wind driven by the falling in of the hills on the caves within--by the falling of the hills which served as roofs to these caverns.

A stone flung through the air leaves on the eye which sees it the impression of its motion, and the same effect is produced by the drops of water which fall from the clouds when it [16] rains.

[17] A mountain falling on a town, will fling up dust in the form of clouds; but the colour of this dust will differ from that of the clouds. Where the rain is thickest let the colour of the dust be less conspicuous and where the dust is thickest let the rain be less conspicuous. And where the rain is mingled with the wind and with the dust the clouds created by the rain must be more transparent than those of dust [alone]. And when flames of fire are mingled with clouds of smoke and water very opaque and dark clouds will be formed [Footnote 26-28: Compare Pl. XL, 1--the drawing in Indian ink on the left hand side, which seems to be a reminiscence of his observations of an eruption (see his remarks on Mount Etna in Vol II).]. And the rest of this subject will be treated in detail in the book on painting.

[Footnote: See the sketches and text on Pl. XXXVIII, No. 1. Lines 1-16 are there given on the left hand side, 17-30 on the right. The four lines at the bottom on the right are given as No. 472. Above these texts, which are written backwards, there are in the original sixteen lines in a larger writing from left to right, but only half of this is here visible. They treat of the physical laws of motion of air and water. It does not seem to me that there is any reason for concluding that this writing from left to right is spurious.

Compare with it the facsimile of the rough copy of Leonardo's letter to Ludovico il Moro in Vol. II.]

611.

People were to be seen eagerly embarking victuals on various kinds of hastily made barks. But little of the waves were visible in those places where the dark clouds and rain were reflected.

But where the flashes caused by the bolts of heaven were reflected, there were seen as many bright spots, caused by the image of the flashes, as there were waves to reflect them to the eye of the spectator.

The number of the images produced by the flash of lightning on the waves of the water were multiplied in proportion to the distance of the spectator's eye.

So also the number of the images was diminished in proportion as they were nearer the eye which saw them [Footnote 22. 23: Com'e provato. See Vol. II, Nos. 874-878 and 892-901], as it has been proved in the definition of the luminosity of the moon, and of our marine horizon when the sun's rays are reflected in it and the eye which receives the reflection is remote from the sea.

VI.

THE ARTIST'S MATERIALS.

Of chalk and paper (612--617).

612.

To make points [crayons] for colouring dry. Temper with a little wax and do not dry it; which wax you must dissolve with water: so that when the white lead is thus tempered, the water being distilled, may go off in vapour and the wax may remain; you will thus make good crayons; but you must know that the colours must be ground with a hot stone.

613.

Chalk dissolves in wine and in vinegar or in aqua fortis and can be recombined with gum.

614.

PAPER FOR DRAWING UPON IN BLACK BY THE AID OF YOUR SPITTLE.

Take powdered gall nuts and vitriol, powder them and spread them on paper like a varnish, then write on it with a pen wetted with spittle and it will turn as black as ink.

615.

If you want to make foreshortened letters stretch the paper in a drawing frame and then draw your letters and cut them out, and make the sunbeams pass through the holes on to another stretched paper, and then fill up the angles that are wanting.

616.

This paper should be painted over with candle soot tempered with thin glue, then smear the leaf thinly with white lead in oil as is done to the letters in printing, and then print in the ordinary way. Thus the leaf will appear shaded in the hollows and lighted on the parts in relief; which however comes out here just the contrary.

[Footnote: This text, which accompanies a facsimile impression of a leaf of sage, has already been published in the *Saggio delle Opere di L. da Vinci*, Milano 1872, p. 11. G. GOVI observes on this passage: "Forse aveva egli pensato ancora a farsi un erbario, od almeno a riprodurre facilmente su carta le forme e i particolari delle foglie di diverse piante; poiche (modificando un metodo che probabilmente gli eia stato insegnato da altri, e che piu tardi si legge ripetuto in molti ricettarii e libri di segreti), accanto a una foglia di Salvia impressa in nero su carta bianca, lascio scritto: Questa carta ...

Erano i primi tentativi di quella riproduzione immediata delle parti vegetali, che poi sotto il nome d'Impressione Naturale, fu condotta a tanta perfezione in questi ultimi tempi dal signor de Hauer e da altri."]

617.

Very excellent will be a stiff white paper, made of the usual mixture and filtered milk of an herb called calves foot; and when this paper is prepared and damped and folded and wrapped up it may be mixed with the mixture and thus left to dry; but if you break it before it is moistened it becomes somewhat like the thin paste called lasagne and you may then damp it and wrap it up and put it in the mixture and leave it to dry; or again this paper may be covered with stiff transparent white and sardonio and then damped so that it may not form angles and then covered up with strong transparent size and as soon as it is firm cut it two fingers, and leave it to dry; again you may make stiff cardboard of sardonio and dry it and then place it between two sheets of papyrus and break it inside with a wooden mallet with a handle and then open it with care holding the lower sheet of paper flat and firm so that the broken pieces be not separated; then have a sheet of paper covered with hot glue and apply it on the top of all these pieces and let them stick fast; then turn it upside down and apply transparent size several times in the spaces between the pieces, each time pouring in

first some black and then some stiff white and each time leaving it to dry; then smooth it and polish it.

On the preparation and use of colours (618-627).

618.

To make a fine green take green and mix it with bitumen and you will make the shadows darker. Then, for lighter [shades] green with yellow ochre, and for still lighter green with yellow, and for the high lights pure yellow; then mix green and turmeric together and glaze every thing with it. To make a fine red take cinnabar or red chalk or burnt ochre for the dark shadows and for the lighter ones red chalk and vermilion and for the lights pure vermilion and then glaze with fine lake. To make good oil for painting. One part of oil, one of the first refining and one of the second.

619.

Use black in the shadow, and in the lights white, yellow, green, vermilion and lake. Medium shadows; take the shadow as above and mix it with the flesh tints just alluded to, adding to it a little yellow and a little green and occasionally some lake; for the shadows take green and lake for the middle shades.

[Footnote 618 and 619: If we may judge from the flourishes with

which the writing is ornamented these passages must have been written in Leonardo's youth.]

620.

You can make a fine ochre by the same method as you use to make white.

621.

A FINE YELLOW.

Dissolve realgar with one part of orpiment, with aqua fortis.

WHITE.

Put the white into an earthen pot, and lay it no thicker than a string, and let it stand in the sun undisturbed for 2 days; and in the morning when the sun has dried off the night dews.

622.

To make reddish black for flesh tints take red rock crystals from Rocca Nova or garnets and mix them a little; again armenian bole is good in part.

623.

The shadow will be burnt ,terra-verte'.

624.

THE PROPORTIONS OF COLOURS.

If one ounce of black mixed with one ounce of white gives a certain shade of darkness, what shade of darkness will be produced by 2 ounces of black to 1 ounce of white?

625.

Remix black, greenish yellow and at the end blue.

626.

Verdigris with aloes, or gall or turmeric makes a fine green and so it does with saffron or burnt orpiment; but I doubt whether in a short time they will not turn black. Ultramarine blue and glass yellow mixed together make a beautiful green for fresco, that is wall-painting. Lac and verdigris make a good shadow for blue in oil painting.

627.

Grind verdigris many times coloured with lemon juice and keep it away from yellow (?).

Of preparing the panel.

628.

TO PREPARE A PANEL FOR PAINTING ON.

The panel should be cypress or pear or service-tree or walnut. You must coat it over with mastic and turpentine twice distilled and white or, if you like, lime, and put it in a frame so that it may expand and shrink according to its moisture and dryness. Then give it [a coat] of aqua vitae in which you have dissolved arsenic or [corrosive] sublimate, 2 or 3 times. Then apply boiled linseed oil in such a way as that it may penetrate every part, and before it is cold rub it well with a cloth to dry it. Over this apply liquid varnish and white with a stick, then wash it with urine when it is dry, and dry it again. Then pounce and outline your drawing finely and over it lay a priming of 30 parts of verdigris with one of verdigris with two of yellow.

[Footnote: M. RAVAISSON'S reading varies from mine in the following passages: