made with cross beams within and without, with planks in contrary directions. And this ship must have attached to it, a foot below the water, an iron-shod spike of about the weight and size of an anvil; and this, by force of oars may, after it has given the first blow, be drawn back, and driven forward again with fury give a second blow, and then a third, and so many as to destroy the other ship.

The use of swimming belts.

1117.

A METHOD OF ESCAPING IN A TEMPEST AND SHIPWRECK AT SEA.

Have a coat made of leather, which must be double across the breast, that is having a hem on each side of about a finger breadth. Thus it will be double from the waist to the knee; and the leather must be quite air-tight. When you want to leap into the sea, blow out the skirt of your coat through the double hems of the breast; and jump into the sea, and allow yourself to be carried by the waves; when you see no shore near, give your attention to the sea you are in, and always keep in your mouth the air-tube which leads down into the coat; and if now and again you require to take a breath of fresh air, and the foam prevents you, you may draw a breath of the air within the coat.

[Footnote: AMORETTI, Memorie Storiche, Tav. II. B. Fig. 5, gives

the same figure, somewhat altered. 6. La canna dell' aria. Compare Vol. I. No. I. Note]

On the gravity of water.

1118.

If the weight of the sea bears on its bottom, a man, lying on that bottom and having l000 braccia of water on his back, would have enough to crush him.

Diving apparatus and Skating (1119-1121).

1119.

Of walking under water. Method of walking on water.

[Footnote: The two sketches belonging to this passage are given by AMORETTI, Memorie Storiche. Tav. II, Fig. 3 and 4.]

1120.

Just as on a frozen river a man may run without moving his feet, so a car might be made that would slide by itself.

[Footnote: The drawings of carts by the side of this text have no

direct connection with the problem as stated in words.--Compare No. 1448, l. 17.]

1121.

A definition as to why a man who slides on ice does not fall.
[Footnote: An indistinct sketch accompanies the passage, in the original.]

On Flying machines (1122-1126).

1122.

Man when flying must stand free from the waist upwards so as to be able to balance himself as he does in a boat so that the centre of gravity in himself and in the machine may counterbalance each other, and be shifted as necessity demands for the changes of its centre of resistance.

1123.

Remember that your flying machine must imitate no other than the bat, because the web is what by its union gives the armour, or strength to the wings.

If you imitate the wings of feathered birds, you will find a much

stronger structure, because they are pervious; that is, their feathers are separate and the air passes through them. But the bat is aided by the web that connects the whole and is not pervious.

1124.

TO ESCAPE THE PERIL OF DESTRUCTION.

Destruction to such a machine may occur in two ways; of which the first is the breaking of the machine. The second would be when the machine should turn on its edge or nearly on its edge, because it ought always to descend in a highly oblique direction, and almost exactly balanced on its centre. As regards the first--the breaking of the machine--, that may be prevented by making it as strong as possible; and in whichever direction it may tend to turn over, one centre must be very far from the other; that is, in a machine 30 braccia long the centres must be 4 braccia one from the other.

[Footnote: Compare No. 1428.]

1125.

Bags by which a man falling from a height of 6 braccia may avoid hurting himself, by a fall whether into water or on the ground; and these bags, strung together like a rosary, are to be fixed on one's back.

1126.

An object offers as much resistance to the air as the air does to the object. You may see that the beating of its wings against the air supports a heavy eagle in the highest and rarest atmosphere, close to the sphere of elemental fire. Again you may see the air in motion over the sea, fill the swelling sails and drive heavily laden ships. From these instances, and the reasons given, a man with wings large enough and duly connected might learn to overcome the resistance of the air, and by conquering it, succeed in subjugating it and rising above it. [Footnote: A parachute is here sketched, with an explanatory remark. It is reproduced on Tav. XVI in the Saggio, and in: Leonardo da Vinci als Ingenieur etc., Ein Beitrag zur Geschichte der Technik und der induktiven Wissenschaften, von Dr. Hermann Grothe, Berlin 1874, p. 50.]

Of mining.

1127.

If you want to know where a mine runs, place a drum over all the places where you suspect that it is being made, and upon this drum put a couple of dice, and when you are over the spot where they are mining, the dice will jump a little on the drum at every blow which is given underground in the mining.

There are persons who, having the convenience of a river or a lake in their lands, have made, close to the place where they suspect that a mine is being made, a great reservoir of water, and have countermined the enemy, and having found them, have turned the water upon them and destroyed a great number in the mine.

Of Greek fire.

1128.

GREEK FIRE.

Take charcoal of willow, and saltpetre, and sulphuric acid, and sulphur, and pitch, with frankincense and camphor, and Ethiopian wool, and boil them all together. This fire is so ready to burn that it clings to the timbers even under water. And add to this composition liquid varnish, and bituminous oil, and turpentine and strong vinegar, and mix all together and dry it in the sun, or in an oven when the bread is taken out; and then stick it round hempen or other tow, moulding it into a round form, and studding it all over with very sharp nails. You must leave in this ball an opening to serve as a fusee, and cover it with rosin and sulphur.

Again, this fire, stuck at the top of a long plank which has one braccio length of the end pointed with iron that it may not be burnt

by the said fire, is good for avoiding and keeping off the ships, so as not to be overwhelmed by their onset.

Again throw vessels of glass full of pitch on to the enemy's ships when the men in them are intent on the battle; and then by throwing similar burning balls upon them you have it in your power to burn all their ships.

[Footnote: Venturi has given another short text about the Greek fire in a French translation (Essai Section XIV). He adds that the original text is to be found in MS. B. 30 (?). Libri speaks of it in a note as follows (Histoire des sciences mathematiques en Italie Vol. II p. 129): La composition du feu gregeois est une des chases qui ont ete les plus cherchees et qui sont encore les plus douteuses. On dit qu'il fut invente au septieme siecle de l'ere chretienne par l'architecte Callinique (Constantini Porphyrogenetae opera, Lugd. Batav. 1617,-- in-8vo; p. 172, de admin, imper. exp. 48), et il se trouve souvent mentionne par les Historiens Byzantins. Tantot on le langait avec des machines, comme on lancerait une banche, tantot on le soufflait avec de longs tubes, comme on soufflerait un gaz ou un liquide enflamme (Annae Comnenae Alexias, p. 335, lib. XI.--Aeliani et Leonis, imperatoris tactica, Lugd.-Bat. 1613, in-4. part. 2 a, p. 322, Leonis tact. cap. l9.--Joinville, histoire du Saint Louis collect. Petitot tom. II, p. 235). Les ecrivains contemporains disent que l'eau ne pouvait pas eteindre ce feu, mais qu'avec du vinaigre et du sable on y

parvenait. Suivant quelques historiens le feu gregeois etait compose de soufre et de resine. Marcus Graecus (Liber ignium, Paris, 1804, in-40) donne plusieurs manieres de le faire qui ne sont pas tres intelligibles, mais parmi lesquelles on trouve la composition de la poudre a canon. Leonard de Vinci (MSS. de Leonard de Vinci, vol. B. f. 30,) dit qu'on le faisait avec du charbon de saule, du salpetre, de l'eau de vie, de la resine, du soufre, de la poix et du camphre. Mais il est probable que nous ne savons pas qu'elle etait sa composition, surtout a cause du secret qu'en faisaient les Grecs. En effet, l'empereur Constantin Porphyrogenete recommende a son fils de ne jamais en donner aux Barbares, et de leur repondre, s'ils en demandaient, qu'il avait ete apporti du ciel par un ange et que le secret en avait ete confie aux Chretiens (Constantini Porphyrogennetae opera, p. 26-27, de admin. imper., cap. 12).]

Of Music (1129. 1130).

1129.

A drum with cogs working by wheels with springs [2].

[Footnote: This chapter consists of explanations of the sketches shown on Pl. CXXI. Lines 1 and 2 of the text are to be seen at the top at the left hand side of the first sketch of a drum. Lines 3-5 refer to the sketch immediately below this. Line 6 is written as the side of the seventh sketch, and lines 7 and 8 at the side of the

eighth. Lines 9-16 are at the bottom in the middle. The remainder of the text is at the side of the drawing at the bottom.]

A square drum of which the parchment may be drawn tight or slackened by the lever a b [5].

A drum for harmony [6].

[7] A clapper for harmony; that is, three clappers together.

[9] Just as one and the same drum makes a deep or acute sound according as the parchments are more or less tightened, so these parchments variously tightened on one and the same drum will make various sounds [16].

Keys narrow and close together; (bicchi) far apart; these will be right for the trumpet shown above.

a must enter in the place of the ordinary keys which have the ... in the openings of a flute.

1130.

Tymbals to be played like the monochord, or the soft flute.

[6] Here there is to be a cylinder of cane after the manner of

clappers with a musical round called a Canon, which is sung in four parts; each singer singing the whole round. Therefore I here make a wheel with 4 teeth so that each tooth takes by itself the part of a singer.

[Footnote: In the original there are some more sketches, to which the text, from line 6, refers. They are studies for a contrivance exactly like the cylinder in our musical boxes.]

1131.

Of decorations.

White and sky-blue cloths, woven in checks to make a decoration.

Cloths with the threads drawn at a b c d e f g h i k, to go round the decoration.

XIX.

Philosophical Maxims. Morals. Polemics and Speculations.

Vasari indulges in severe strictures on Leonardo's religious views. He speaks, among other things, of his "capricci nel filosofar delle cose naturali" and says on this point: "Per il che fece nell'animo un concetto si eretico che e' non si accostava a qualsi voglia

religione, stimando per avventura assai piu lo esser filosofo che cristiano" (see the first edition of 'Le Vite'). But this accusation on the part of a writer in the days of the Inquisition is not a very serious one--and the less so, since, throughout the manuscripts, we find nothing to support it.

Under the heading of "Philosophical Maxims" I have collected all the passages which can give us a clear comprehension of Leonardo's ideas of the world at large. It is scarcely necessary to observe that there is absolutely nothing in them to lead to the inference that he was an atheist. His views of nature and its laws are no doubt very unlike those of his contemporaries, and have a much closer affinity to those which find general acceptance at the present day. On the other hand, it is obvious from Leonardo's will (see No. 1566) that, in the year before his death, he had professed to adhere to the fundamental doctrines of the Roman Catholic faith, and this evidently from his own personal desire and impulse.

The incredible and demonstrably fictitious legend of Leonardo's death in the arms of Francis the First, is given, with others, by Vasari and further embellished by this odious comment: "Mostrava tuttavia quanto avea offeso Dio e gli uomini del mondo, non avendo operato nell'arte come si conveniva." This last accusation, it may be remarked, is above all evidence of the superficial character of the information which Vasari was in a position to give about

Leonardo. It seems to imply that Leonardo was disdainful of diligent labour. With regard to the second, referring to Leonardo's morality and dealings with his fellow men, Vasari himself nullifies it by asserting the very contrary in several passages. A further refutation may be found in the following sentence from the letter in which Melsi, the young Milanese nobleman, announces the Master's death to Leonardo's brothers: Credo siate certificati della morte di Maestro Lionardo fratello vostro, e mio quanto optimo padre, per la cui morte sarebbe impossibile che io potesse esprimere il dolore che io ho preso; e in mentre che queste mia membra si sosterranno insieme, io possedero una perpetua infelicita, e meritamente perche sviscerato et ardentissimo amore mi portava giornalmente. E dolto ad ognuno la perdita di tal uomo, quale non e piu in podesta della natura, ecc.

It is true that, in April 1476, we find the names of Leonardo and Verrocchio entered in the "Libro degli Uffiziali di notte e de' Monasteri" as breaking the laws; but we immediately after find the note "Absoluti cum condizione ut retamburentur" (Tamburini was the name given to the warrant cases of the night police). The acquittal therefore did not exclude the possibility of a repetition of the charge. It was in fact repeated, two months later, and on this occasion the Master and his pupil were again fully acquitted. Verrocchio was at this time forty and Leonardo four-and-twenty. The documents referring to this affair are in the State Archives of Florence; they have been withheld from publication, but it seemed to

me desirable to give the reader this brief account of the leading facts of the story, as the vague hints of it, which have recently been made public, may have given to the incident an aspect which it had not in reality, and which it does not deserve.

The passages here classed under the head "Morals" reveal Leonardo to us as a man whose life and conduct were unfailingly governed by lofty principles and aims. He could scarcely have recorded his stern reprobation and unmeasured contempt for men who do nothing useful and strive only for riches, if his own life and ambitions had been such as they have so often been misrepresented.

At a period like that, when superstition still exercised unlimited dominion over the minds not merely of the illiterate crowd, but of the cultivated and learned classes, it was very natural that Leonardo's views as to Alchemy, Ghosts, Magicians, and the like should be met with stern reprobation whenever and wherever he may have expressed them; this accounts for the argumentative tone of all his utterances on such subjects which I have collected in Subdivision III of this section. To these I have added some passages which throw light on Leonardo's personal views on the Universe. They are, without exception, characterised by a broad spirit of naturalism of which the principles are more strictly applied in his essays on Astronomy, and still more on Physical Geography.

To avoid repetition, only such notes on Philosophy, Morals and

Polemics, have been included in this section as occur as independent texts in the original MSS. Several moral reflections have already been given in Vol. I, in section "Allegorical representations, Mottoes and Emblems". Others will be found in the following section. Nos. 9 to 12, Vol. I, are also passages of an argumentative character. It did not seem requisite to repeat here these and similar passages, since their direct connection with the context is far closer in places where they have appeared already, than it would be here.

I.

PHILOSOPHICAL MAXIMS.

Prayers to God (1132. 1133).

1132.

I obey Thee Lord, first for the love I ought, in all reason to bear Thee; secondly for that Thou canst shorten or prolong the lives of men.

1133.

A PRAYER.

Thou, O God, dost sell us all good things at the price of labour.

The powers of Nature (1134-1139).

1134.

O admirable impartiality of Thine, Thou first Mover; Thou hast not permitted that any force should fail of the order or quality of its necessary results.

1135.

Necessity is the mistress and guide of nature.

Necessity is the theme and the inventress, the eternal curb and law of nature.

1136.

In many cases one and the same thing is attracted by two strong forces, namely Necessity and Potency. Water falls in rain; the earth absorbs it from the necessity for moisture; and the sun evaporates it, not from necessity, but by its power.

1137.

Weight, force and casual impulse, together with resistance, are the four external powers in which all the visible actions of mortals have their being and their end.

1138.

Our body is dependant on heaven and heaven on the Spirit.

1139.

The motive power is the cause of all life.

Psychology (1140-1147).

1140.

And you, O Man, who will discern in this work of mine the wonderful works of Nature, if you think it would be a criminal thing to destroy it, reflect how much more criminal it is to take the life of a man; and if this, his external form, appears to thee marvellously constructed, remember that it is nothing as compared with the soul that dwells in that structure; for that indeed, be it what it may, is a thing divine. Leave it then to dwell in His work at His good will and pleasure, and let not your rage or malice destroy a life--for indeed, he who does not value it, does not himself deserve it [Footnote 19: In MS. II 15a is the note: chi no stima la vita,

non la merita.].

[Footnote: This text is on the back of the drawings reproduced on Pl. CVII. Compare No. 798, 35 note on p. 111: Compare also No. 837 and 838.]

1141.

The soul can never be corrupted with the corruption of the body,, but is in the body as it were the air which causes the sound of the organ, where when a pipe bursts, the wind would cease to have any good effect. [Footnote: Compare No. 845.]

1142.

The part always has a tendency to reunite with its whole in order to escape from its imperfection.

The spirit desires to remain with its body, because, without the organic instruments of that body, it can neither act, nor feel anything.

1143.

If any one wishes to see how the soul dwells in its body, let him observe how this body uses its daily habitation; that is to say, if

this is devoid of order and confused, the body will be kept in disorder and confusion by its soul.

1144.

Why does the eye see a thing more clearly in dreams than with the imagination being awake?

1145.

The senses are of the earth; Reason, stands apart in contemplation.

[Footnote: Compare No. 842.]

1146.

Every action needs to be prompted by a motive.

To know and to will are two operations of the human mind.

Discerning, judging, deliberating are acts of the human mind.

1147.

All our knowledge has its origin in our preceptions.

Science, its principles and rules (1148--1161)

1148.

Science is the observation of things possible, whether present or past; prescience is the knowledge of things which may come to pass, though but slowly.

1149.

Experience, the interpreter between formative nature and the human race, teaches how that nature acts among mortals; and being constrained by necessity cannot act otherwise than as reason, which is its helm, requires her to act.

1150.

Wisdom is the daughter of experience.

1151.

Nature is full of infinite causes that have never occured in experience.

1152.

Truth was the only daughter of Time.

1153.

Experience never errs; it is only your judgments that err by promising themselves effects such as are not caused by your experiments.

Experience does not err; only your judgments err by expecting from her what is not in her power. Men wrongly complain of Experience; with great abuse they accuse her of leading them astray but they set Experience aside, turning from it with complaints as to our ignorance causing us to be carried away by vain and foolish desires to promise ourselves, in her name, things that are not in her power; saying that she is fallacious. Men are unjust in complaining of innocent Experience, constantly accusing her of error and of false evidence.

1154.

Instrumental or mechanical science is of all the noblest and the most useful, seeing that by means of this all animated bodies that have movement perform all their actions; and these movements are based on the centre of gravity which is placed in the middle dividing unequal weights, and it has dearth and wealth of muscles and also lever and counterlever.

1155.

OF MECHANICS.

Mechanics are the Paradise of mathematical science, because here we come to the fruits of mathematics. [Footnote: Compare No. 660, 11. 19--22 (Vol. I., p. 332). 1156.

Every instrument requires to be made by experience.

1157.

The man who blames the supreme certainty of mathematics feeds on confusion, and can never silence the contradictions of sophistical sciences which lead to an eternal quackery.

1158.

There is no certainty in sciences where one of the mathematical sciences cannot be applied, or which are not in relation with these mathematics.

1159.

Any one who in discussion relies upon authority uses, not his

understanding, but rather his memory. Good culture is born of a good disposition; and since the cause is more to be praised than the effect, I will rather praise a good disposition without culture, than good culture without the disposition.

1160.

Science is the captain, and practice the soldiers.

1161.

OF THE ERRORS OF THOSE WHO DEPEND ON PRACTICE WITHOUT SCIENCE.

Those who fall in love with practice without science are like a sailor who enters a ship without a helm or a compass, and who never can be certain whither he is going.

II.

MORALS.

What is life? (1162. 1163).

1162.

Now you see that the hope and the desire of returning home and to one's former state is like the moth to the light, and that the man who with constant longing awaits with joy each new spring time, each new summer, each new month and new year--deeming that the things he longs for are ever too late in coming--does not perceive that he is longing for his own destruction. But this desire is the very quintessence, the spirit of the elements, which finding itself imprisoned with the soul is ever longing to return from the human body to its giver. And you must know that this same longing is that quintessence, inseparable from nature, and that man is the image of the world.

1163.

O Time! consumer of all things; O envious age! thou dost destroy all things and devour all things with the relentless teeth of years, little by little in a slow death. Helen, when she looked in her mirror, seeing the withered wrinkles made in her face by old age, wept and wondered why she had twice been carried away.

O Time! consumer of all things, and O envious age! by which all things are all devoured.

Death.

1164.

Every evil leaves behind a grief in our memory, except the supreme evil, that is death, which destroys this memory together with life.

How to spend life (1165-1170).

1165.

0 sleepers! what a thing is slumber! Sleep resembles death. Ah, why then dost thou not work in such wise as that after death thou mayst retain a resemblance to perfect life, when, during life, thou art in sleep so like to the hapless dead? [Footnote: Compare No. 676, Vol. I. p. 353.]

1166.

One pushes down the other.

By these square-blocks are meant the life and the studies of men.

1167.

The knowledge of past times and of the places on the earth is both an ornament and nutriment to the human mind.

1168.

To lie is so vile, that even if it were in speaking well of godly things it would take off something from God's grace; and Truth is so excellent, that if it praises but small things they become noble.

Beyond a doubt truth bears the same relation to falsehood as light to darkness; and this truth is in itself so excellent that, even when it dwells on humble and lowly matters, it is still infinitely above uncertainty and lies, disguised in high and lofty discourses; because in our minds, even if lying should be their fifth element, this does not prevent that the truth of things is the chief nutriment of superior intellects, though not of wandering wits.

But you who live in dreams are better pleased by the sophistical reasons and frauds of wits in great and uncertain things, than by those reasons which are certain and natural and not so far above us.

1169.

Avoid studies of which the result dies with the worker.

1170.

Men are in error when they lament the flight of time, accusing it of being too swift, and not perceiving that it is sufficient as it passes; but good memory, with which nature has endowed us, causes

things long past to seem present.

1171.

Learning acquired in youth arrests the evil of old age; and if you understand that old age has wisdom for its food, you will so conduct yourself in youth that your old age will not lack for nourishment.

1172.

The acquisition of any knowledge is always of use to the intellect, because it may thus drive out useless things and retain the good.

For nothing can be loved or hated unless it is first known.

1173.

As a day well spent procures a happy sleep, so a life well employed procures a happy death.

1174.

The water you touch in a river is the last of that which has passed, and the first of that which is coming. Thus it is with time present.

Life if well spent, is long.

1175.

Just as food eaten without caring for it is turned into loathsome nourishment, so study without a taste for it spoils memory, by retaining nothing which it has taken in.

1176.

Just as eating against one's will is injurious to health, so study without a liking for it spoils the memory, and it retains nothing it takes in.

1177.

On Mount Etna the words freeze in your mouth and you may make ice of them.[Footnote 2: There is no clue to explain this strange sentence.]

Just as iron rusts unless it is used, and water putrifies or, in cold, turns to ice, so our intellect spoils unless it is kept in use.

You do ill if you praise, and still worse if you reprove in a matter you do not understand.

When Fortune comes, seize her in front with a sure hand, because behind she is bald.

1178.

It seems to me that men of coarse and clumsy habits and of small knowledge do not deserve such fine instruments nor so great a variety of natural mechanism as men of speculation and of great knowledge; but merely a sack in which their food may be stowed and whence it may issue, since they cannot be judged to be any thing else than vehicles for food; for it seems to me they have nothing about them of the human species but the voice and the figure, and for all the rest are much below beasts.

1179.

Some there are who are nothing else than a passage for food and augmentors of excrement and fillers of privies, because through them no other things in the world, nor any good effects are produced, since nothing but full privies results from them.

On foolishness and ignorance (1180--1182).

1180.

The greatest deception men suffer is from their own opinions.

1181.

Folly is the shield of shame, as unreadiness is that of poverty glorified.

1182.

Blind ignorance misleads us thus and delights with the results of lascivious joys.

Because it does not know the true light. Because it does not know what is the true light.

Vain splendour takes from us the power of being .... behold! for its vain splendour we go into the fire, thus blind ignorance does mislead us. That is, blind ignorance so misleads us that ...

O! wretched mortals, open your eyes.

On riches (1183--1187).

1183.

That is not riches, which may be lost; virtue is our true good and the true reward of its possessor. That cannot be lost; that never

deserts us, but when life leaves us. As to property and external riches, hold them with trembling; they often leave their possessor in contempt, and mocked at for having lost them.

1184.

Every man wishes to make money to give it to the doctors, destroyers of life; they then ought to be rich. [Footnote 2: Compare No. 856.]

Man has much power of discourse which for the most part is vain and false; animals have but little, but it is useful and true, and a small truth is better than a great lie.

1185.

He who possesses most must be most afraid of loss.

1186.

He who wishes to be rich in a day will be hanged in a year.

1187.

That man is of supreme folly who always wants for fear of wanting; and his life flies away while he is still hoping to enjoy the good things which he has with extreme labour acquired.

Rules of Life (1188-1202).

1188.

If you governed your body by the rules of virtue you would not walk on all fours in this world.

You grow in reputation like bread in the hands of a child.
[Footnote: The first sentence is obscure. Compare Nos. 825, 826.]

1189.

Savage he is who saves himself.

1190.

We ought not to desire the impossible. [Footnote: The writing of this note, which is exceedingly minute, is reproduced in facsimile on Pl. XLI No. 5 above the first diagram.

1191.

Ask counsel of him who rules himself well.

Justice requires power, insight, and will; and it resembles the

queen-bee.

He who does not punish evil commands it to be done.

He who takes the snake by the tail will presently be bitten by it.

The grave will fall in upon him who digs it.

1192.

The man who does not restrain wantonness, allies himself with beasts.

You can have no dominion greater or less than that over yourself.

He who thinks little, errs much.

It is easier to contend with evil at the first than at the last.

No counsel is more loyal than that given on ships which are in peril: He may expect loss who acts on the advice of an inexperienced youth.

1193.

Where there is most feeling, there is the greatest martyrdom;--a

great martyr.

1194.

The memory of benefits is a frail defence against ingratitude.

Reprove your friend in secret and praise him openly.

Be not false about the past.

1195.

A SIMILE FOR PATIENCE.

Patience serves us against insults precisely as clothes do against the cold. For if you multiply your garments as the cold increases, that cold cannot hurt you; in the same way increase your patience under great offences, and they cannot hurt your feelings.

1196.

To speak well of a base man is much the same as speaking ill of a good man.

1197.

Envy wounds with false accusations, that is with detraction, a thing which scares virtue.

1198.

We are deceived by promises and time disappoints us ... [Footnote 2: The rest of this passage may be rendered in various ways, but none of them give a satisfactory meaning.]

1199.

Fear arises sooner than any thing else.

1200.

Just as courage imperils life, fear protects it.

Threats alone are the weapons of the threatened man.

Wherever good fortune enters, envy lays siege to the place and attacks it; and when it departs, sorrow and repentance remain behind.

He who walks straight rarely falls.

It is bad if you praise, and worse if you reprove a thing, I mean,

if you do not understand the matter well.

It is ill to praise, and worse to reprimand in matters that you do not understand.

1201.

Words which do not satisfy the ear of the hearer weary him or vex him, and the symptoms of this you will often see in such hearers in their frequent yawns; you therefore, who speak before men whose good will you desire, when you see such an excess of fatigue, abridge your speech, or change your discourse; and if you do otherwise, then instead of the favour you desire, you will get dislike and hostility.

And if you would see in what a man takes pleasure, without hearing him speak, change the subject of your discourse in talking to him, and when you presently see him intent, without yawning or wrinkling his brow or other actions of various kinds, you may be certain that the matter of which you are speaking is such as is agreeable to him &c.

1202.

The lover is moved by the beloved object as the senses are by sensible objects; and they unite and become one and the same thing.

The work is the first thing born of this union; if the thing loved is base the lover becomes base.

When the thing taken into union is perfectly adapted to that which receives it, the result is delight and pleasure and satisfaction.

When that which loves is united to the thing beloved it can rest there; when the burden is laid down it finds rest there.

Politics (1203. 1204).

1203.

There will be eternal fame also for the inhabitants of that town, constructed and enlarged by him.

All communities obey and are led by their magnates, and these magnates ally themselves with the lords and subjugate them in two ways: either by consanguinity, or by fortune; by consanguinity, when their children are, as it were, hostages, and a security and pledge of their suspected fidelity; by property, when you make each of these build a house or two inside your city which may yield some revenue and he shall have…; 10 towns, five thousand houses with thirty thousand inhabitants, and you will disperse this great congregation of people which stand like goats one behind the other, filling every place with fetid smells and sowing seeds of pestilence

and death;

And the city will gain beauty worthy of its name and to you it will be useful by its revenues, and the eternal fame of its aggrandizement.

[Footnote: These notes were possibly written in preparation for a letter. The meaning is obscure.]

1204.

To preserve Nature's chiefest boon, that is freedom, I can find means of offence and defence, when it is assailed by ambitious tyrants, and first I will speak of the situation of the walls, and also I shall show how communities can maintain their good and just Lords.

[Footnote: Compare No. 1266.]

III.

POLEMICS.--SPECULATION.

Against Speculators (1205. 1206).

1205.

Oh! speculators on things, boast not of knowing the things that nature ordinarily brings about; but rejoice if you know the end of those things which you yourself devise.

1206.

Oh! speculators on perpetual motion how many vain projects of the like character you have created! Go and be the companions of the searchers for gold. [Footnote: Another short passage in MS. I, referring also to speculators, is given by LIBRI (Hist, des Sciences math. III, 228): Sicche voi speculatori non vi fidate delli autori che anno sol col immaginatione voluto farsi interpreti tra la natura e l'omo, ma sol di quelli che non coi cienni della natura, ma cogli effetti delle sue esperienze anno esercitati i loro ingegni.]

Against alchemists (1207. 1208).

1207.

The false interpreters of nature declare that quicksilver is the common seed of every metal, not remembering that nature varies the seed according to the variety of the things she desires to produce in the world.

1208.

And many have made a trade of delusions and false miracles, deceiving the stupid multitude.

Against friars.

1209.

Pharisees--that is to say, friars.

[Footnote: Compare No. 837, 11. 54-57, No. 1296 (p. 363 and 364), and No. 1305 (p. 370).]

Against writers of epitomes.

1210.

Abbreviators do harm to knowledge and to love, seeing that the love of any thing is the offspring of this knowledge, the love being the more fervent in proportion as the knowledge is more certain. And this certainty is born of a complete knowledge of all the parts, which, when combined, compose the totality of the thing which ought to be loved. Of what use then is he who abridges the details of those matters of which he professes to give thorough information, while he leaves behind the chief part of the things of which the

whole is composed? It is true that impatience, the mother of stupidity, praises brevity, as if such persons had not life long enough to serve them to acquire a complete knowledge of one single subject, such as the human body; and then they want to comprehend the mind of God in which the universe is included, weighing it minutely and mincing it into infinite parts, as if they had to dissect it!

Oh! human stupidity, do you not perceive that, though you have been with yourself all your life, you are not yet aware of the thing you possess most of, that is of your folly? and then, with the crowd of sophists, you deceive yourselves and others, despising the mathematical sciences, in which truth dwells and the knowledge of the things included in them. And then you occupy yourself with miracles, and write that you possess information of those things of which the human mind is incapable and which cannot be proved by any instance from nature. And you fancy you have wrought miracles when you spoil a work of some speculative mind, and do not perceive that you are falling into the same error as that of a man who strips a tree of the ornament of its branches covered with leaves mingled with the scented blossoms or fruit..... [Footnote 48: Givstino, Marcus Junianus Justinus, a Roman historian of the second century, who compiled an epitome from the general history written by Trogus Pompeius, who lived in the time of Augustus. The work of the latter writer no longer exist.] as Justinus did, in abridging the histories written by Trogus Pompeius, who had written in an ornate style all

the worthy deeds of his forefathers, full of the most admirable and ornamental passages; and so composed a bald work worthy only of those impatient spirits, who fancy they are losing as much time as that which they employ usefully in studying the works of nature and the deeds of men. But these may remain in company of beasts; among their associates should be dogs and other animals full of rapine and they may hunt with them after...., and then follow helpless beasts, which in time of great snows come near to your houses asking alms as from their master....

On spirits (1211--1213).

1211.

O mathematicians shed light on this error.

The spirit has no voice, because where there is a voice there is a body, and where there is a body space is occupied, and this prevents the eye from seeing what is placed behind that space; hence the surrounding air is filled by the body, that is by its image.

1212.

There can be no voice where there is no motion or percussion of the air; there can be no percussion of the air where there is no instrument, there can be no instrument without a body; and this

being so, a spirit can have neither voice, nor form, nor strength. And if it were to assume a body it could not penetrate nor enter where the passages are closed. And if any one should say that by air, compressed and compacted together, a spirit may take bodies of various forms and by this means speak and move with strength--to him I reply that when there are neither nerves nor bones there can be no force exercised in any kind of movement made by such imaginary spirits.

Beware of the teaching of these speculators, because their reasoning is not confirmed by experience.

1213.

Of all human opinions that is to be reputed the most foolish which deals with the belief in Necromancy, the sister of Alchemy, which gives birth to simple and natural things. But it is all the more worthy of reprehension than alchemy, because it brings forth nothing but what is like itself, that is, lies; this does not happen in Alchemy which deals with simple products of nature and whose function cannot be exercised by nature itself, because it has no organic instruments with which it can work, as men do by means of their hands, who have produced, for instance, glass &c. but this Necromancy the flag and flying banner, blown by the winds, is the guide of the stupid crowd which is constantly witness to the dazzling and endless effects of this art; and there are books full,

declaring that enchantments and spirits can work and speak without tongues and without organic instruments-- without which it is impossible to speak-- and can carry heaviest weights and raise storms and rain; and that men can be turned into cats and wolves and other beasts, although indeed it is those who affirm these things who first became beasts.

And surely if this Necromancy did exist, as is believed by small wits, there is nothing on the earth that would be of so much importance alike for the detriment and service of men, if it were true that there were in such an art a power to disturb the calm serenity of the air, converting it into darkness and making coruscations or winds, with terrific thunder and lightnings rushing through the darkness, and with violent storms overthrowing high buildings and rooting up forests; and thus to oppose armies, crushing and annihilating them; and, besides these frightful storms may deprive the peasants of the reward of their labours.--Now what kind of warfare is there to hurt the enemy so much as to deprive him of the harvest? What naval warfare could be compared with this? I say, the man who has power to command the winds and to make ruinous gales by which any fleet may be submerged, --surely a man who could command such violent forces would be lord of the nations, and no human ingenuity could resist his crushing force. The hidden treasures and gems reposing in the body of the earth would all be made manifest to him. No lock nor fortress, though impregnable, would be able to save any one against the will of the necromancer.

He would have himself carried through the air from East to West and through all the opposite sides of the universe. But why should I enlarge further upon this? What is there that could not be done by such a craftsman? Almost nothing, except to escape death. Hereby I have explained in part the mischief and the usefulness, contained in this art, if it is real; and if it is real why has it not remained among men who desire it so much, having nothing to do with any deity? For I know that there are numberless people who would, to satisfy a whim, destroy God and all the universe; and if this necromancy, being, as it were, so necessary to men, has not been left among them, it can never have existed, nor will it ever exist according to the definition of the spirit, which is invisible in substance; for within the elements there are no incorporate things, because where there is no body, there is a vacuum; and no vacuum can exist in the elements because it would be immediately filled up. Turn over.

1214.

OF SPIRITS.

We have said, on the other side of this page, that the definition of a spirit is a power conjoined to a body; because it cannot move of its own accord, nor can it have any kind of motion in space; and if you were to say that it moves itself, this cannot be within the elements. For, if the spirit is an incorporeal quantity, this

quantity is called a vacuum, and a vacuum does not exist in nature; and granting that one were formed, it would be immediately filled up by the rushing in of the element in which the vacuum had been generated. Therefore, from the definition of weight, which is this--Gravity is an accidental power, created by one element being drawn to or suspended in another--it follows that an element, not weighing anything compared with itself, has weight in the element above it and lighter than it; as we see that the parts of water have no gravity or levity compared with other water, but if you draw it up into the air, then it would acquire weight, and if you were to draw the air beneath the water then the water which remains above this air would acquire weight, which weight could not sustain itself by itself, whence collapse is inevitable. And this happens in water; wherever the vacuum may be in this water it will fall in; and this would happen with a spirit amid the elements, where it would continuously generate a vacuum in whatever element it might find itself, whence it would be inevitable that it should be constantly flying towards the sky until it had quitted these elements.

AS TO WHETHER A SPIRIT HAS A BODY AMID THE ELEMENTS.

We have proved that a spirit cannot exist of itself amid the elements without a body, nor can it move of itself by voluntary motion unless it be to rise upwards. But now we will say how such a spirit taking an aerial body would be inevitably melt into air; because if it remained united, it would be separated and fall to

form a vacuum, as is said above; therefore it is inevitable, if it is to be able to remain suspended in the air, that it should absorb a certain quantity of air; and if it were mingled with the air, two difficulties arise; that is to say: It must rarefy that portion of the air with which it mingles; and for this cause the rarefied air must fly up of itself and will not remain among the air that is heavier than itself; and besides this the subtle spiritual essence disunites itself, and its nature is modified, by which that nature loses some of its first virtue. Added to these there is a third difficulty, and this is that such a body formed of air assumed by the spirits is exposed to the penetrating winds, which are incessantly sundering and dispersing the united portions of the air, revolving and whirling amidst the rest of the atmosphere; therefore the spirit which is infused in this

1215.

air would be dismembered or rent and broken up with the rending of the air into which it was incorporated.

AS TO WHETHER THE SPIRIT, HAVING TAKEN THIS BODY OF AIR, CAN MOVE OF

ITSELF OR NOT.

It is impossible that the spirit infused into a certain quantity of air, should move this air; and this is proved by the above passage

where it is said: the spirit rarefies that portion of the air in which it incorporates itself; therefore this air will rise high above the other air and there will be a motion of the air caused by its lightness and not by a voluntary movement of the spirit, and if this air is encountered by the wind, according to the 3rd of this, the air will be moved by the wind and not by the spirit incorporated in it.

AS TO WHETHER THE SPIRIT CAN SPEAK OR NOT.

In order to prove whether the spirit can speak or not, it is necessary in the first place to define what a voice is and how it is generated; and we will say that the voice is, as it were, the movement of air in friction against a dense body, or a dense body in friction against the air,--which is the same thing. And this friction of the dense and the rare condenses the rare and causes resistance; again, the rare, when in swift motion, and the rare in slow motion condense each other when they come in contact and make a noise and very great uproar; and the sound or murmur made by the rare moving through the rare with only moderate swiftness, like a great flame generating noises in the air; and the tremendous uproar made by the rare mingling with the rare, and when that air which is both swift and rare rushes into that which is itself rare and in motion, it is like the flame of fire which issues from a big gun and striking against the air; and again when a flame issues from the cloud, there is a concussion in the air as the bolt is generated.

Therefore we may say that the spirit cannot produce a voice without movement of the air, and air in it there is none, nor can it emit what it has not; and if desires to move that air in which it is incorporated, it is necessary that the spirit should multiply itself, and that cannot multiply which has no quantity. And in the 4th place it is said that no rare body can move, if it has not a stable spot, whence it may take its motion; much more is it so when an element has to move within its own element, which does not move of itself, excepting by uniform evaporation at the centre of the thing evaporated; as occurs in a sponge squeezed in the hand held under water; the water escapes in every direction with equal movement through the openings between the fingers of the hand in which it is squeezed.

As to whether the spirit has an articulate voice, and whether the spirit can be heard, and what hearing is, and seeing; the wave of the voice passes through the air as the images of objects pass to the eye.

Nonentity.

1216.

Every quantity is intellectually conceivable as infinitely divisible.

[Amid the vastness of the things among which we live, the existence of nothingness holds the first place; its function extends over all things that have no existence, and its essence, as regards time, lies precisely between the past and the future, and has nothing in the present. This nothingness has the part equal to the whole, and the whole to the part, the divisible to the indivisible; and the product of the sum is the same whether we divide or multiply, and in addition as in subtraction; as is proved by arithmeticians by their tenth figure which represents zero; and its power has not extension among the things of Nature.]

[What is called Nothingness is to be found only in time and in speech. In time it stands between the past and future and has no existence in the present; and thus in speech it is one of the things of which we say: They are not, or they are impossible.]

With regard to time, nothingness lies between the past and the future, and has nothing to do with the present, and as to its nature it is to be classed among things impossible: hence, from what has been said, it has no existence; because where there is nothing there would necessarily be a vacuum.

[Footnote: Compare No. 916.]

Reflections on Nature (1217-1219).

1217.

EXAMPLE OF THE LIGHTNING IN CLOUDS.

[O mighty and once living instrument of formative nature. Incapable of availing thyself of thy vast strength thou hast to abandon a life of stillness and to obey the law which God and time gave to procreative nature.]

Ah! how many a time the shoals of terrified dolphins and the huge tunny-fish were seen to flee before thy cruel fury, to escape; whilst thy fulminations raised in the sea a sudden tempest with buffeting and submersion of ships in the great waves; and filling the uncovered shores with the terrified and desperate fishes which fled from thee, and left by the sea, remained in spots where they became the abundant prey of the people in the neighbourhood.

O time, swift robber of all created things, how many kings, how many nations hast thou undone, and how many changes of states and of various events have happened since the wondrous forms of this fish perished here in this cavernous and winding recess. Now destroyed by time thou liest patiently in this confined space with bones stripped and bare; serving as a support and prop for the superimposed mountain.

[Footnote: The character of the handwriting points to an early