XXII. *Experiments and Observations on the Matter of Cancer, and on the aërial Fluids extricated from animal Substances by Distillation and Putrefaction ; together with some Remarks on sulphureous hepatic Air.* By Adair Crawford, *M. D. F. R. S.*

Read June 17, 1790.

THERE are feveral varieties in the colour and confiftence of the matter difcharged by cancerous ulcers. It is in fome cafes of a pale afh colour; in others, it has a reddifh caft; and in many inftances it has more or lefs of a brown tinge, fometimes approaching nearly to black. Its confiftence is for the moft part thin ; but in the cancerous, as well as in other malignant ulcers, we frequently meet with a white fordes, which clofely adheres to the furface of the fore, and which appears to be fcarcely mifcible with water. In the fame patient the appearance of the difcharge is frequently varied by internal remedies, or by external applications; but if we except the temporary variations produced by accidental circum-ftances, the cancerous ulcer is, in its advanced ftage, very generally accompanied with a peculiar odour more highly fetid and offenfive than that which is emitted by other malignant ulcers.

It is well known, that the cancerous matter occafions by its abforption fchirrous tumors of the lymphatic glands contiguous to the parts affected ; and that it gradually corrodes the
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branches of the larger blood-veſſels, which have a peculiar power of reſiſting the action of other purulent diſcharges.

Apprehending that ſome light might poſſibly be thrown upon the nature of cancerous diſeaſes, by enquiring into the properties of this ſubſtance, I procured a portion of it from a patient who had for ſeveral years been afflicted with a cancer in the breaſt. Having diffuſed it through pure water, I divided it into three parts, which were put into ſmall glaſs veſſels. To one of theſe I added a ſolution of vegetable fixed alkali; to the ſecond, a little concentrated vitriolic acid; and to the third, ſyrup of violets. By the vegetable fixed alkali no ſenſible change was produced: upon the addition of the vitriolic acid, the liquor in the ſecond glaſs acquired a deep brown colour, a briſk efferveſcence took place, and at the ſame time the peculiar odour of the cancerous matter was greatly encreaſed, and diffuſed itſelf to a conſiderable diſtance through the ſurrounding air. The ſyrup of violets communicated to the liquor in the third glaſs a faint green colour.

The cancerous matter uſed in theſe experiments had a browniſh caſt. It had been imbibed by cotton, and kept for ſome days before the trials were made.

Mr. GEBER has ſhewn, that animal ſubſtances upon their firſt putrefaction do not efferveſce with acids; that, after the proceſs has continued for ſome time, a manifeſt efferveſcence takes place; and that this effect again diſappears before the putrefaction has ceaſed.

Suſpecting that the efferveſcence in the preceding experiment might have ariſen from a change which the matter underwent, in conſequence of its having been kept ſome days before the trial was made, I repeated the experiment with a portion of reddiſh matter recently obtained from a cancerous penis. Upon

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the addition of the acid, the liquor, as before, acquired a brown colour, its fetor was much increafed, and a manifeft effervefcence took place, although it was not fo confiderable as in the former inftance. A portion of the fame matter diffufed through diftilled water communicated a blue tinge to tincture of litmus, and a greenifh caft to fyrup of violets.

It is proper to obferve, that when fyrup of violets was mixed with portions of cancerous matter from a variety of different fubjects, the change produced was in fome cafes fcarcely perceptible; but in every inftance the prefence of an alkali was detected by dipping into the matter a flip of paper that had been previoufly tinged blue by tincture of litmus, and afterwards flightly reddened by acetous acid. The red colour was invariably in the courfe of a few minutes abolifhed, and the blue reftored.

The cancerous matter, as has been already remarked, acquired, upon the addition of the vitriolic acid, a brown hue. It is well known, that this acid, when it is highly concentrated, communicates a brown or black colour to all animal and vegetable fubftances. Being defirous of learning whether the change which took place upon the addition of the acid to the cancerous matter in this experiment, was different from that which would be produced by the fame acid in other animal fubftances, and particularly in recent healthy pus; I took equal quantities of the latter, and of afh-coloured cancerous matter, and having diffufed each of them through thrice its weight of diftilled water, I added to them equal quantities of concentrated vitriolic acid; the weight of the acid being nearly the fame with that of the matter ufed in the experiment. The mixture containing the pus acquired from the acid a faint brown colour; but that which contained the cancerous matter, was

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fuddenly changed to a deep brown, approaching to black.
When thefe mixtures were diluted with about twice their
weight of diftilled water, the brown tinge of the former en-
tirely difappeared; but the latter ftill retained its brown colour,
although it was fomewhat fainter than it had been upon the firft
addition of the acid.

The aërial fluid which was difengaged in the foregoing trials
from the matter of cancer, by the vitriolic acid, appeared from
its odour to have a nearer refemblance to hepatic than to any
other fpecies of air. As it feemed, from its fenfible qualities,
to be a very active, and probably a deleterious principle, I
endeavoured more particularly to enquire into its nature, and
to compare it with common hepatic air. But before I relate
the trials which were made with that view, it may not be im-
proper briefly to mention the characters by which common he-
patic air is diftinguifhed.

It has a fmell refembling that of rotten eggs; it is inflam-
mable, and during its combuftion in the open air, fulphur is
depofited; it communicates a black colour to filver and copper,
and a brownifh tinge to lead and iron; it is foluble in water,
and when a folution of nitrated filver is dropped into water
impregnated with it, the mixture becomes turbid, and a dark-
coloured precipitate falls to the bottom; by the addition of
the nitrated filver, the odour of the hepatic air is rendered
much fainter; and it is entirely deftroyed by concentrated ni-
trous, or by dephlogifticated marine acid.

To determine whether the aërial fluid contained in the can-
cerous matter poffeffed thefe properties, a portion of this fub-
ftance was diffufed through diftilled water. The mixture
being filtered, a fmall quantity of nitrated filver was dropped
into it. In a little time, an afh-coloured cloud was produced,
                                                    which

which foon afterwards acquired a brownifh purple hue, and at the end of two hours the colour of the mixture was changed to a deep brown. The fetid fmell was now rendered much fainter than that of a fimilar mixture of cancerous matter, and of diftilled water, to which nitrated filver had not been added. When a little concentrated nitrous acid was dropped into the mixture which had been thus altered by the addition of nitrated filver, a flight effervefcence took place, the brown hue was inftantly changed to an orange colour, and the fetid fmell was abolifhed. The fetor was likewife entirely deftroyed, when dephlogifti-cated marine acid was added either to cancerous matter in its feparate ftate, or to a portion of that fubftance which had been previoufly mixed with nitrated filver.

By the foregoing properties the cancerous virus is diftinguifhed from common pus: for when dilute vitriolic acid is added to com-mon pus, no effervefcence is produced; and when a folution of nitrated filver is dropped into this fubftance previoufly diffufed through diftilled water, the mixture does not acquire a brown co-lour; nor does any fenfible precipitation take place for feveral hours. It appeared, however, that when the laft experiment was repeated with matter obtained from a venereal bubo, the mixture upon the addition of the nitrated filver became flightly turbid, and, at the end of two hours, it acquired a brownifh caft. The fame effects were perceived when the trial was made with mat-ter obtained from a carious bone. But in thefe inftances the precipitation was much lefs confiderable than that which was produced by the cancerous matter.

I next endeavoured to procure, in its feparate ftate, a por-tion of the air which is extricated from the matter of cancer by the vitriolic acid. With this intention a quantity of red-difh cancerous matter was mixed in a fmall proof, with about

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thrice its weight of diftilled water. To this mixture a little vitriolic acid was added; upon which an effervefcence took place, and the air that was difengaged was received in a phial over mercury. When one half of the mercury was expelled from the phial, the latter was inverted over diftilled water, and the portion of the mercury that remained in it being fuffered to defcend, and the water to rife into its place, the phial was clofely corked. The air and water were then brifkly agitated together, and the phial being a fecond time inverted over diftilled water, the cork was removed; when it appeared by the heighth to which the water rofe, that a part of the air had been abforbed. The water contained in the phial was now found to be ftrongly impregnated with the odour of the cancerous matter, and a little nitrated filver being dropped into it, a purplifh cloud, inclining to red, was produced. It is proper to obferve, that the change of colour upon the addition of the nitrated filver, in this experiment, was at firft fcarcely perceptible; but in the courfe of a few minutes it became very diftinct. As it might perhaps be doubtful, whether this alteration would not be produced in the nitrated filver by expofure to the air alone, the colour of the mixture was compared with that of a fimilar mixture of nitrated filver and of pure diftilled water, which had remained expofed to the open air for an equal length of time. Although a flight change of colour was produced in the latter inftance, yet it was much lefs confiderable than that which took place in the former.

In the above recited experiment, the air came over mixed with the common air that was contained in the proof. The quantity of aërial fluid that can be thus extricated by the addition of the acid without the affiftance of heat, is not very confiderable.

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If heat be applied, a larger portion of fetid air, having the odour of cancerous matter, may be difengaged; but in that cafe it will be found to be mixed with vitriolic acid air.

With a view to obtain the former of thefe fluids in as pure a ftate as poffible, the experiment was repeated in the following manner. A portion of the cancerous virus, diffufed through diftilled water, was introduced into a fmall proof; a little vitriolic acid was added; the veffel was filled with diftilled water, and a crooked tube, alfo filled with that fluid, was fixed to its neck. The extremity of the tube being then introduced into the mouth of an inverted bottle containing water, and the flame of a candle being applied to the bottom of the proof, a quantity of air was expelled, which was received in the bottle. This air, when it was firft difengaged, rofe in the form of white bubbles; it had a very fetid fmell, fimilar to that of the cancerous matter; and the water which was impregnated with it occafioned a dark-brown precipitate in a folution of nitrated filver. The crooked tube being feparated from the proof, a very offenfive white vapour, refembling in its odour the air extricated during the experiment, arofe from the mixture, and continued to afcend for nearly half an hour. When to a portion of this fmoking liquor, previoufly filtered, a little concentrated nitrous acid was added, the fetid fmell was entirely deftroyed, a flight effervefcence took place, and a flaky fubftance that floated through the mixture was difengaged.

The foregoing experiments prove, in general, that the fetid odour of the matter of cancer is increafed by the vitriolic, but entirely deftroyed by the concentrated nitrous and dephlogifticated marine acids; that the aërial fluid, which is difengaged by the vitriolic acid, is foluble in water; and that the folu-

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tion depofits a reddifh brown precipitate upon the addition of nitrated filver. Whence it follows, that the cancerous matter contains a principle which has many of the properties of hepatic air, and which may perhaps not improperly be termed animal hepatic air.

It has moreover been fhewn, that the matter of cancer is impregnated with an alkali which is in fuch a ftate as to change the colour of vegetable tinctures. I had very little doubt that this was the volatile alkali: for it is well known, that putrid animal fubftances frequently abound with that falt; but have never, I believe, been found to contain a fixed alkali in a difengaged ftate. With a view, however, more decifively to determine this point, I tried the following experiment. A quantity of cancerous matter, diffufed through diftilled water, was introduced into a glafs retort to which a receiver was adapted. The mixture was flowly diftilled by means of a fand heat; and a fmall quantity of the liquor which came over into the receiver being poured into an infufion of Brazil wood, inftantly imparted to it a deep red colour.

Hence it clearly appears, that the alkali contained in the cancerous matter was the volatile, becaufe it was feparated by diftillation with a heat which did not exceed that of boiling water.

It feemed extremely probable, that the above-mentioned alkali was united to the aërial fluid with which the matter of cancer is impregnated. Of the truth of this fact I was perfuaded by obferving, that the fmell of the cancerous matter was greatly increafed by the addition of the vitriolic acid: for I could fcarcely avoid concluding, that this phænomenon arofe from an union between the acid and alkali, in confequence of which the odoriferous principle was extricated by a fuperior attraction.

attraction. This conclusion will be confirmed by experiments to be recited in the sequel, which prove, that the volatile alkali is capable of entering into a chemical combination with the aërial fluid contained in the matter of cancer.

Of the air extricated from cancerous matter, and from other animal substances, by distillation.

A portion of matter from a cancerous breast was diffused through distilled water, and introduced into a small coated glass retort, which was gradually exposed to heat in a sand bath till the bottom of the retort became red-hot. The neck of the latter was introduced below an inverted jar filled with water, and a quantity of air was received in the jar, which was found to consist of the common air contained in the retort. Two measures of it, mixed with one of nitrous air, occupied the space of a little less than two measures. This portion of air was strongly impregnated with the peculiar smell of the cancerous matter.

The heat continuing to increase, the water began to boil, and a large quantity of aqueous vapour arose; which, as soon as it came into contact with the common air, produced a white smoke. The smell that was now perceived was remarked by those who were present to be similar to that of fresh animal substances when they are boiled. The aqueous vapour in this part of the process was not mixed with any permanently elastic fluid.

When the greater part of the water was evaporated, the jar containing the first portion of air was removed, and the neck of the retort was introduced beneath an inverted vessel filled with mercury. Soon after this, a considerable quantity of air, having a fetid smell similar to that of burned bones, was extricated.

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cated. This aërial fluid was mixed with a yellow empyreu-matic oil. A portion of it being agitated with water was found to be partly imbibed by that fluid; and nitrated filver, dropped into the water thus impregnated, produced a reddifh precipitate.

One meafure of the air, obtained in the foregoing experi-ment, being mixed over mercury with an equal bulk of alka-line air, the volume of the mixture was found gradually to decreafe; and, at the end of three hours, the air in the tube occupied the fpace of only one meafure and two tenths. An oily depofit was now made upon the inner furface of the tube. At the expiration of eight days, the interior furface of the tube was covered with flender films, which had a yellowifh caft, and which were irregularly fpread upon it. The upper furface of the mercury within the tube was corroded; in fome places it had a reddifh burnifhed appearance; in others, it was changed into an afh-coloured powder, interfperfed with brown fpots. The tube was now removed from the mercury, and the air that remained in it had a ftrong fetid fmell, refembling that of burned bones.

It has been already obferved, that before the water was en-tirely evaporated, the vapour had loft the odour of the can-cerous matter, and had acquired that of animal fubftances recently boiled. Hence it appears, that the matter upon which the peculiar fmell of cancerous ulcers depends, is a very vola-tile fubftance, for it efcaped at the beginning of the procefs. It alfo appears, that this volatile fubftance, which is probably the active principle in the matter of cancer, is not changed, by fimple expofure to heat, into a permanently elaftic fluid; for the air that efcaped at the beginning of the procefs, although it fmelled ftrongly of the cancerous matter, was found by Dr.

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Priestley's teft to be as pure as common air; and it was evident, that the aqueous vapour which came over in the middle of the procefs was not mixed with any permanently elaftic fluid; becaufe, when this vapour was received in an inverted bottle filled with mercury, it was condenfed into water, without any admixture of air. Indeed, if the odoriferous principle in the matter of cancer confift of volatile alkali combined with animal hepatic air, it could not be expected that it fhould acquire a permanently elaftic form by fimple expofure to heat; becaufe when alkaline and animal hepatic air unite together, they form a non-elaftic fubftance that condenfes upon the inner furface of the veffel in which they are mixed.

To difcover whether other animal fubftances yield an aërial fluid, fimilar to that which was extricated in the foregoing experiment from the matter of cancer by means of heat, a portion of the flefh of the neck of a chicken was introduced into a fmall coated glafs retort, which was gradually expofed to heat in a fand bath till it became red-hot. A thin phlegm, of a yellowifh colour, firft came over: this was foon fucceeded by a yellow empyreumatic oil, and at the fame time a permanently elaftic fluid, having an odour refembling that of burned feathers, began to be difengaged. A flip of paper, tinged with litmus and reddened by acetous acid, being held over this fluid, became blue. The neck of the retort was now introduced below an inverted jar filled with mercury, and a confiderable quantity of air, together with a fetid empyreumatic oil, were received in the jar. This air was highly inflammable: it had a very fetid odour. When a bottle, containing a portion of it, was agitated with diftilled water, nearly one-half of it was abforbed. The refidue was inflammable, and burned firft with a flight explofion, and afterwards with a blue lambent flame. A little nitrated filver being dropped into the

water with which the air had been agitated, the mixture in-
ftantly acquired a reddifh brown colour; after fome time it
became turbid, and a brown precipitate fell to the bottom.
When two meafures of the air, extricated in this experiment,
were mixed with one of alkaline air, they occupied the fpace
of a little more than one meafure and an half. A fecond
meafure of alkaline air being added, and the airs being fuffered
to remain together for three days, at the end of that time the
refidue occupied the fpace of two meafures and one-eighth.
Soon after they were mixed, an oily fluid, of a pale colour,
was depofited on the internal furface of the jar. At the end
of the third day this fubftance had acquired a light olive
colour. It was collected in globules, irregularly diftributed
over the interior furface of the jar. Thefe globules were
nearly of a folid confiftence. When the jar was removed from
the mercury, the air contained in it at firft fmelled ftrongly of
volatile alkali. After a little time the fmell of the alkali
difappeared, and the odour of empyreumatic oil was diftinctly
perceived. A fmall quantity of diftilled water, which was
now agitated in the jar, acquired a brown colour, but did not
entirely diffolve the vifcid fubftance that adhered to its furface.
The water, thus coloured, was divided into two portions. To
one of thefe was added a little ftrong vitriolic acid, by which
the fmell was exalted, and a flight effervefcence was produced.
Concentrated nitrous acid being added to the other portion, the
fmell and colour were deftroyed, and a brifk effervefcence took
place.

When a portion of the folid fubftance that adhered to the
interior furface of the jar was feparated, it felt vifcid and
adhefive between the fingers, and fmelled ftrongly of empy-
reumatic oil. A little fpirit of wine being introduced into the

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jar, this vifcid fubftance was diffolved; the fpirit acquired a yellow colour and empyreumatic fmell, and upon adding to it diftilled water the mixture became whitifh and flightly turbid.

I next examined the air extricated from putrid veal by diftillation. A portion of the latter fubftance being introduced into a coated glafs retort was expofed to a red heat, and the air difengaged was received in a jar over mercury. This aërial fluid was found to poffefs nearly the fame properties with that which was obtained in the preceding experiments. It was very inflammable; about one-half of it was foluble in diftilled water. The water, thus impregnated, became turbid upon the addition of nitrated filver, and a brown precipitate fell to the bottom. To another portion of diftilled water faturated with this fluid, dephlogifticated marine acid being added, the fetid fmell was deftroyed, a brifk effervefcence took place, and a whitifh gelatinous fubftance was feparated. This fubftance being evaporated to drynefs, became black upon the addition of concentrated vitriolic acid. When a quantity of the air obtained in the experiment was agitated with diftilled water until no more was abforbed, the refidue took fire upon the application of an ignited body, and burned with a lambent flame. It is proper to obferve, that the air extricated from the putrid veal had lefs of the empyreumatic fmell than that which was difengaged from frefh animal fubftances. Its odour indeed was nearly fimilar to that of animal fubftances in a ftate of putrefaction.

We learn from thefe experiments that the aërial fluids, which are extricated from frefh as well as from putrid animal fubftances by diftillation, have nearly the fame properties with that which is difengaged, by a fimilar procefs, from the matter of cancer. Each of them appears to confift of two diftinct fluids; one of which is foluble, and the other infoluble, in

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water. The portion that is infoluble burns with a lambent flame, and has all the characters of heavy inflammable air; whereas the foluble part refembles the fluid which is extricated from cancerous matter by the vitriolic acid : it has a fetid odour, it decompofes nitrated filver, combines with cauftic volatile alkali, and pofleffes many of the properties of common hepatic air.

There are feveral particulars, however, in which the animal and common hepatic air materially differ from each other. Although they are both fetid, yet their odours are not exactly fimilar. When common hepatic air is decompofed by the con-centrated nitrous or dephlogifticated marine acid, fulphur is feparated; but when animal hepatic air is decompofed by thefe acids, a white flaky matter is difengaged which is evidently an animal fubftance, becaufe it becomes black by the addition of concentrated vitriolic acid. Sulphur is moreover feparated during the combuftion of common hepatic with atmofpherical air; but when the air from animal fubftances is burned with atmofpherical air, no precipitation of fulphur takes place. Indeed, that animal hepatic air does not contain fulphur will be apparent from the following experiment.

Equal parts of pure air and of air extricated from frefh beef by diftillation, were fired by the electric fhock in a ftrong glafs tube over mercury. A little diftilled water was then introduced through the mercury into the tube, and was agitated with the air which it contained. A portion of this water being filtered, and a fmall quantity of muriated barytes being dropped into it, the mixture remained perfectly tranfparent. Hence it appears, that the air extricated from frefh beef by diftillation does not contain fulphur; for, if it had contained that fubftance, the fulphur, by its combuftion with the pure air, would have been

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changed into the vitriolic acid, and the muriated barytes would have been decompofed.

I frequently repeated the preceding experiment with the air extricated, by diftillation, from the putrid as well as from the frefh mufcular fibres of animals; but I could not, in any inftance, difcover the leaft veftige of the vitriolic acid.

The following experiments were made with a view more accurately to analyfe the airs which are difengaged from animal fubftances by heat, and to determine the products refulting from the union of thefe fluids with pure air.

About an ounce of the lean of frefh mutton was introduced into a fmall coated glafs retort, and expofed to a red heat. The air that was extricated towards the end of the diftillation was received over mercury; and foon after its production, being agitated with water, very nearly one half of it was abforbed. A fimilar experiment being made with the air difengaged towards the middle of the diftillation, the part of it which was foluble in water was found to be to the part not foluble in that fluid as 2 to 3. Having fuffered a feparate portion of the air difengaged towards the end of the diftillation to remain over mercury for feven hours, it was found gradually to diminifh in bulk, and a fluid, which had the colour and the odour of a thin empyreumatic oil, was collected at the bottom of the jar *. The air being now agitated with water, only one-eighth of it was abforbed. Hence it appears, that a portion of the air, extricated from animal fubftances by heat, refembles a fpecies of hepatic air which was firft difcovered by Mr. KIRWAN, and which exifts in an intermediate ftate between the aërial and the vaporous; this fluid not being permanently elaftic like

* The above-mentioned appearance is not conftant. The air when placed over mercury fometimes diminifhes, and at other times it retains its original bulk. I have not as yet difcovered the caufe of this difference.

air, nor immediately condenfed by cold like vapour, but gra-
dually affuming the non-elaftic form, in confequence probably
of the tendency of its feveral parts to unite with each other.

The air produced in the foregoing experiment rendered lime-
water turbid; it therefore contained a quantity of fixed air;
and towards the end of the diftillation a little volatile alkaline
air came over, agreeably to the obfervation of M. BERTHOLLET:
for, when a portion of the air received during this part of the
procefs was mixed with an equal quantity of marine acid air, a
white vapour was produced, and a diminution of about one
twenty-fifth of the whole took place.

I endeavoured, by the following experiment, to afcertain the
proportion of fixed air contained in the aërial fluid which is dif-
engaged from the lean of animal fubftances by heat.

A quantity of air, extricated from the lean of frefh mutton,
was received over mercury in a large phial which had a narrow
neck. When the phial was a little more than half filled, the
remaining portion of the mercury was difplaced by introducing
water that had been previoufly boiled. The phial being then
clofely corked, the air and water were brifkly agitated together;
and the liquor, thus impregnated with the foluble part of the
animal air, was put into a proof, to the bottom of which heat
was applied. By this means a portion of the air was again difen-
gaged, which was received in a tube inverted over mercury. The
procefs was continued till the liquor in the proof no longer ren-
dered lime-water turbid. As the air received in the tube contained
the fixed air that had been extricated from the liquor, together
with a quantity of common air expelled from the proof, it was a
fecond time agitated with water; and the exact meafure of the
fixed air was known by the portion which the water imbibed.
The fixed air, thus afcertained, being compared with the entire
quantity of air that had been originally abforbed, it appeared,

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that the former was to the latter in bulk as 1 to 4. One-fourth therefore of the volume of the foluble part of animal air confifts of fixed air, and the remaining three-fourths of hepatic, mixed with a very fmall proportion of alkaline air *.

It appeared from the experiment, that animal hepatic air, when it was abforbed by water, was not capable of being again difengaged by a heat which raifed the water to the boiling temperature; for, after the fixed air was expelled, the liquor in the proof was made to boil nearly half an hour, but no permanently elaftic fluid could be difengaged. The portion of the liquor which now remained had a faint yellow colour; it fmelled ftrongly of animal hepatic air, and depofited a brown precipitate upon the addition of nitrated filver.

It appears, therefore, that the foluble part of the air which is difengaged from the lean of animal fubftances by heat, confifts of three diftinct fluids; of alkaline air, fixed air, and animal hepatic air. It feemed extremely probable, that thefe three aërial fluids, flowly combining together, formed the oily empyreumatic fubftance which was collected at the bottom of the jar, while the air was undergoing the diminution defcribed above. In this conclufion I was confirmed by trials that were made with the empyreumatic oil that came over during the latter part of the diftillation: for when it was examined by chemical tefts, foon after it was obtained, it was found to contain fixed air, volatile alkali, and animal hepatic air.

* It is proper to remark, that, in fome experiments, the relative quantity of animal hepatic air was found to be lefs than that which has been ftated above. I do not as yet know, with certainty, the caufes to which this difference is to be attributed; but I believe it principally depends upon the period of the diftillation in which the air is received, the degree of heat applied to the bottom of the retort, and the nature of the animal fubftance employed in the experiment.

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I next endeavoured to determine the products which refult from the combuftion of pure air, with animal air, or with the compound aërial fluid extricated from the lean of animal fub-ftances by heat. With this intention I expofed the lean of frefh mutton, in a fmall coated glafs retort, to a red heat. The air which was received over mercury towards the end of the diftillation was divided into two feparate portions; one of which was agitated with water till the foluble part was ab-forbed; the other was not agitated with that fluid. One mea-fure of the former was introduced, over mercury, into a ftrong glafs tube adapted for the purpofe of firing aërial fluids by the electric fhock. This was mixed with one meafure and an half of pure air. The portion of the tube occupied by the mixture was one inch and two-tenths. A fmall fhock being made to pafs through it, a violent explofion took place, and the fpace occupied by the refidue was nine-tenths of an inch. The height of the mercury in the tube, previoufly to the combuftion, was 4.8 inches. After the airs were fired, its height was 5.1 inches. Allowance being made for the difference of expanfion produced by this caufe, it appeared, that the volumes of the airs, previoufly to the combuftion, and fubfequent to it, were as 100 to 75 nearly. The refidue being agitated with water, fix-tenths were abforbed; and the portion which was thus ab-forbed was found, by the precipitation which it produced in lime water, to be fixed air. Of the infoluble remainder, five parts being mixed with five of nitrous air, a diminution of three parts took place; whence it follows, that one-fifth of the infoluble refidue was pure air.

The pure air which was ufed in this experiment had been previoufly agitated with water, to free it entirely from fixed air, and the inflammable air had undergone a fimilar agitation.

It

It is therefore manifeft, that, by the combuftion of the pure and inflammable air in the foregoing trial, fixed air was pro-duced; the phlogifticated air, found in the refidue, being that which was contained in the pure air before the inflammation took place.

I next examined the products refulting from the combuftion of pure air with that portion of the animal air which had not been previoufly agitated with water. One meafure of this fluid, at the expiration of three-fourths of an hour after it had been obtained, was mixed over mercury with one meafure and an half of pure air, and fired by the electric fhock. The portion of the tube occupied by the mixture, previoufly to the deflagration, was one inch and $\frac{15}{100}$; after the deflagration, it occupied the fpace of one inch and one-tenth. Being agitated with lime-water, very nearly one-third was abforbed. A por-tion of the infoluble refidue was expofed to a lighted taper, and burned with a faint blue flame *.

The dephlogifticated air ufed in this experiment had been previoufly agitated with water, to free it entirely from fixed air. It was the pureft dephlogifticated air I had ever feen : for when one meafure of it was mixed with one meafure and nine-tenths of nitrous air, the refidue occupied the fpace of only one-fortieth of a meafure. From the foregoing trial it was evident, that $1\frac{1}{2}$ parts of pure air were infufficient to faturate one of the animal air that had not been previoufly agitated with water. The experiment was therefore repeated as follows. Two

* When I firft made the above experiment, the refidue did not appear to be inflammable. It had been tried by applying an inflamed flip of paper to the mouth of a phial which was filled with it; but, upon repeating the experiment, when the phial containing the refiduary air was carried into a dark room, and an ignited wax taper was applied to its mouth, an evident inflammation took place.

parts of pure air being mixed with one of animal air, occupied .8 of an inch. The mixture being fired by the electrical shock, the residue stood at a little less than .5. When this residue was agitated with lime-water, it was almost wholly absorbed. By a subsequent trial it was found, that nearly one-half of the animal air used in this experiment was soluble in water.

Hence it appears, that the quantity of pure air required to saturate the insoluble part of the animal air is somewhat less than that required to saturate the compound fluid which had not been previously agitated with water. But the latter fluid has been shewn to consist almost entirely of heavy inflammable, animal hepatic, and fixed air; and as the last of these is already saturated with pure air, it is manifest, that the above-mentioned difference must depend upon the animal hepatic air. Whence it follows, that the latter contains a large portion of the inflammable principle. From the quantity of fixed air produced in the last of the preceding experiments, there is, moreover, the utmost reason to believe, that the basis of heavy inflammable forms one of the constituent parts of animal hepatic air.

When equal parts of pure and animal air were burned together, a considerable increase of bulk almost invariably took place; and when the proportion of the animal was to that of pure air as 21 to 15, the bulk of the mixture was increased one half. The air that remained after the combustion in the last mentioned experiments was inflammable: for a portion of it being introduced into a small phial, and exposed to a lighted candle, it first exploded, and then burned with a blue lambent flame.

Being desirous of learning the cause of the increase of bulk in the foregoing experiments, the following trials were made.

Three meafures of animal were mixed with two of pure air, and feveral ftrong electrical fhocks were made to pafs through the mixture, but it would not take fire. Half a meafure of pure air was then added, and the mixture being fired, its bulk was encreafed from .9 of an inch to 1 inch and .3.

Three meafures of this refiduary air were then mixed with three of pure air, and fired by the electric fhock. The bulk of the mixture was reduced from 1 inch to .56. This being agitated with lime-water, two-thirds were abforbed, and the remainder confifted almoft wholly of pure air. From thefe facts it feems probable, that animal hepatic air confifts of a combination of heavy and light inflammable air; and that when it is fired with a quantity of pure air not fufficient to faturate it, a portion of the animal air is refolved into its elementary principles, in confequence of which its bulk is encreafed.

It was before obferved, that three parts of animal mixed with two of pure air would not take fire. In fome experiments it was found, that when the animal air was mixed with a ftill fmaller proportion of pure air, an increafe of bulk was produced by the electric fhock, although no deflagration took place; but when the electric fhock was repeatedly taken through animal air *alone*, it did not in any inftance, as far as I could perceive, produce the fmalleft increafe of fize.

I was next defirous of learning whether an increafe of fize would be produced by making the electric fhock pafs through a mixture of pure and alkaline air. Having firft accidentally taken two or three fmall fhocks through a little alkaline air, and not obferving a fenfible augmentation of bulk, I then mixed it with an equal volume of pure air; and, as I fuppofed that no decompofition had taken place, I was not apprehenfive

H h h 2   of

of an explofion.   Contrary, however, to my expectation, the
airs, when the electric fhock was made to pafs through them,
entered rapidly into an union with each other.   The jar which
I held loofely in my hand, as it was inverted over the mercury,
was carried obliquely upwards with great violence.   Having
broken the ftand of the prime conductor in its paffage, it
forced its way through the cylinder of the electrical machine,
which it fhivered to a thoufand pieces.

I afterwards repeated this experiment with a very ftrong
apparatus, the jar being preffed down by a plate of iron, for
the purpofe of retaining it in its place.

It appeared, that when the alkaline and pure air were imme-
diately mixed together, and a fmall fhock was made to pafs
through them, they would not take fire; but when three or
four fhocks were previoufly taken through the alkaline air, and
the latter was afterwards mixed with an equal bulk of pure
air, they exploded with great violence.   The refidue, having
cooled to the temperature of the furrounding air, was reduced
to half the original bulk of the mixture.   Of this refidue one-
fixth was undecompofed alkaline air.   The remainder was
phlogifticated air.

Of the products which refult from the combuftion of fulphureous
hepatic with pure air.

The hepatic air employed in the following experiments was
procured, agreeably to the method which Mr. KIRWAN has
recommended, by adding marine acid to an artificial combination
of fulphur and iron.   Three meafures of the air thus obtained
were mixed in a ftrong glafs tube over mercury, with four of
pure air, and fired by the electric fhock.

The

The pure air was previoufly agitated with lime-water to free it from fixed air, and a portion of the hepatic air, having been likewife agitated with lime-water, was found not to occafion any precipitation in that fluid. The airs were reduced by the explofion to one-fourth of their original bulk. The refidue was then transferred over mercury into a flender graduated tube, and diftilled water being admitted, eight-tenths were abforbed. To a portion of this water, when filtered, vitriolated filver was added, which inftantly occafioned a copious precipi-tate. To a fecond portion was added muriated barytes, which occafioned a flight white precipitate not re-diffolvable in a large quantity of water; lime-water being added to a third portion, did not produce any fenfible precipitation. From the laft fact it does not follow, that no fixed air exifted in the refidue, be-caufe the marine acid, which it evidently contained, would diffolve the calcareous earth of the lime-water. As a great diminution, however, refulted from the combuftion; and as it appeared, from chemical tefts, that the refidue was moftly com-pofed of marine and vitriolic acid airs, it is manifeft, that, if any fixed air was produced, its quantity muft have been very inconfiderable.

It has been already obferved, that a flight precipitation took place upon the addition of the muriated barytes. The precipi-tate was much more confiderable when, upon repeating the experiment, the refidue after the explofion was not tranf-ferred into a graduated tube previoufly to the admiffion of the diftilled water; but the latter was immediately introduced into the veffel in which the airs were fired. The reafon of this difference is evident. The flight precipitate by the muriated barytes, in the firft inftance, depended upon the exiftence of a fmall quantity of vitriolic acid in an aërial form, or in the

ftate

ftate of volatile vitriolic acid, which was transferred together with the phlogifticated and marine acid air into the fecond tube; but the greater part of the vitriolic acid produced by the combuftion adhered, in a fixed ftate, to the furface of the tube in which the airs were fired; and therefore, when the diftilled water was immediately introduced into this tube, a copious precipitate was depofited upon the addition of muriated barytes.

Hence it appears, that when pure air and fulphureous hepatic air, obtained from artificial pyrites by the marine acid, are fired together in the above proportions, the products are fixed vitriolic acid, together with a fmall quantity of the volatile vitriolic, and marine acids, in an aërial form. The refidue, which the diftilled water did not abforb, was the phlogifticated air that exifted in the pure air previoufly to the combuftion.

From fubfequent trials it appeared, that, when hepatic and pure air were fired in equal bulks, the refidue had a ftrong odour of volatile vitriolic acid, and moreover contained a fmall proportion of undecompofed hepatic air. Thefe facts feem to prove, that the converfion of fulphur into volatile or fixed vitriolic acid depends upon the quantity of pure air with which it is fupplied.

The marine acid air, found in this experiment, did not appear to form one of the conftituent principles of the hepatic air, but to be merely diffufed through it; for it was almoft wholly feparated, by means of diftilled water, from a different portion of the fame air, which was placed in a tube inverted over mercury; the water having a ftronger attraction to the marine acid than to the hepatic air.

By the following experiment I endeavoured to determine
whether

whether vitriolic acid be produced by the combuftion of he-
patic with atmofpherical air. One meafure of hepatic air,
obtained from artificial pyrites, was mixed over mercury with
about fix meafures of atmofpherical air, and fired by the elec-
tric fhock. A copious precipitation of fulphur took place, the
remaining air was then agitated with diftilled water, the latter
was filtered, and muriated barytes was added, which pro-
duced a white precipitate not diffoluble in a large quantity of
water.

From this, and the foregoing experiment, it appears, that
when fulphureous hepatic is burned with atmofpherical air, a
part of the fulphur is changed into vitriolic acid, and the reft
is precipitated; but when it is burned with a fufficient quan-
tity of pure air, the fulphur is wholly converted into vitriolic
acid. Agreeably to this conclufion, I have found that the
odour of the volatile vitriolic acid conftantly accompanies the
combuftion of hepatic with common air in open veffels; and
that when concentrated nitrous acid is added to water impreg-
nated with hepatic air, the filtered liquor becomes turbid upon
the addition of muriated barytes.

The quantity of pure air required to faturate fulphureous
hepatic air, does not appear to correfpond with the fuppofition
that the laft of thefe fluids confifts of fulphur diffolved in
light inflammable air: for fulphur, in order to its complete
faturation, requires only 1.43 times its weight of pure air;
but light inflammable air requires for its faturation at leaft fix
times its weight of that fluid. The fpecific gravity of hepatic
air, as determined by Mr. KIRWAN, is nearly equal to that of
pure air. If, therefore, one-fixth of the weight of hepatic
confifted of light inflammable air, that fluid would require for
its faturation 2.26 times its bulk of pure air: for the portion
of

of it which confifted of light inflammable air would require a quantity of pure air equal in bulk to the hepatic; and the remaining portion, confifting of fulphur, would require a quantity equal to 1.26 of the hepatic. The entire quantity of pure air would therefore be to that of the hepatic as 2.26 to 1. If the hepatic contained one-twelfth of its weight of light inflammable air, it would require for its faturation 1.64 of its bulk of pure air. But from the foregoing experiments it appears, that the quantity of pure air, neceffary to faturate one meafure of hepatic air, is only 1.33 meafures. Hence it is probable, that this fluid does not confift of fulphur diffolved in light inflammable air.

If we make allowance for the marine acid which was diffufed through the hepatic air, it will be found, that the quantity of pure air required to faturate it is nearly the fame with that which would be required to change an equal weight of fulphur into vitriolic acid. Whence it may be inferred, agreeably to the opinion of Mr. KIRWAN, that hepatic air is fulphur which has acquired an aërial form by the application of heat. This conclufion is, I think, confirmed by the following experiment.

A little pure fulphur was introduced into an inverted tube, which had been previoufly filled with mercury, and the flame of a candle was applied to the extremity of the tube. In a fhort time a permanently elaftic fluid was produced, which was found to have all the charaćters of hepatic air. It is probable, however, that fome degree of moifture is neceffary to the fuccefs of this experiment, becaufe the quantity of hepatic air which was thus obtained was not very confiderable.

It has been already fhewn, that an oily matter was produced by the union between fixed air, volatile alkali, and animal

hepatic

hepatic air. The following experiment proves, that a fub-
ftance, which has very much the appearance of oil, is formed by
the combination of *fulphureous* hepatic air with fixed air and
volatile alkali.

A quantity of impure hepatic air was obtained by adding
vitriolic acid to common liver of fulphur. When this fluid
was agitated with lime-water, it produced a copious precipita-
tion. It therefore contained a confiderable proportion of fixed
air. One meafure of it was now introduced into a flender
graduated tube, inverted over mercury, and was mixed with an
equal bulk of alkaline air. As foon as the airs came into contact
with each other, a white cloud was produced, the mercury
began gradually to rife in the tube, and at the end of fix hours
the air that remained occupied the fpace of only one meafure
and one-third. The furface of the mercury within the tube
firft became black, and a part of it afterwards acquired a red
colour refembling cinnabar. In the courfe of the experiment,
a yellowifh oleaginous fubftance was depofited upon the inte-
rior furface of the tube. This fubftance, in fome parts of the
furface, formed itfelf into globules; in others, it was extended
into ramifications, having the refemblance of trees in minia-
ture, and it gradually affumed a deeper colour, till at length it
acquired a greenifh caft. The fubftance, thus obtained, had a
very fetid odour: it appeared to have a near refemblance to an
animal oil which had become green by putrefaction. It was,
however, foluble in water, and the odour of the folution was
increafed by the vitriolic, and deftroyed by the concentrated
nitrous and dephlogifticated marine acids.

Mr. CRUIKSHANK, who affifted me in moft of the fore-
going experiments, and on whofe accuracy I could place the
greateft reliance, examined, in my abfence, the red and black

powders which were formed by the action of the hepatic air upon the furface of the mercury, and found them to be æthiops mineral, and cinnabar.

Of the air extricated from animal fubftances by putrefaction.

In the beginning of July, 1789, about two ounces of veal, flightly putrid, was introduced into a large phial, which was filled with diftilled water, and inverted over a quantity of the fame fluid. At the end of three days a few bubbles of air had appeared at the bottom of the phial; the water had acquired a light brown colour, and emitted a fetid fmell. At the expiration of feven days we could perceive that the quantity of air at the bottom of the phial was manifeftly increafed, although its progrefs was very flow. The water, by the diffolution of a part of the veal, had now acquired the confiftence of a thin mucus, its brown colour was fomewhat deepened, and it emitted a highly fetid fmell. A little nitrated filver being dropped into a portion of this water, previoufly filtered, a dark brown precipitate was immediately produced. Lime-water, mixed with another portion of it, occafioned an afh-coloured precipitate; and when concentrated nitrous acid was added to a third portion, the fetid fmell was deftroyed, a flight effervefcence took place, and a yellow flaky matter was difengaged. At the end of feven weeks, a quantity of air, amounting to two and one-fixth dram meafures was collected in the phial. This air had a fetid odour. Being agitated with water, fix-tenths of it was abforbed. The refidue extinguifhed flame.

I next examined the air extricated from veal which was fuffered to putrefy over mercury.

On

On the 28th of July, 1789, two drams and twenty-four grains of the lean of fresh veal was introduced into a narrow jar, which was filled with mercury, and inverted over that fluid. At the end of eight days the air, which was flowly extricated, had communicated a brown colour to the surface of the mercury. On the 13th of September, the quantity of air disengaged was a little more than two ounce measures. This fluid had a very fetid smell. Two separate portions of distilled water being saturated with it, the first, upon the addition of nitrated silver, deposited a brown precipitate; and the last, when it was mixed with lime-water, produced a brownish ash-coloured cloud. A third portion of the air being strongly agitated with distilled water, was reduced to one-sixteenth of its original bulk. The residue extinguished flame.

The veal which had remained so long in contact with the mercury had not lost its firm texture. Its smell was putrid, but not very offensive.

The quantity of elastic fluid collected in this experiment was much greater than in the preceding one; because in the preceding experiment, although the putrefaction advanced more rapidly, yet the fixed and hepatic air were absorbed by the water nearly as fast as they were disengaged from the putrid substance.

Hence it appears, that the aërial fluids, which are extricated from the muscular fibres of animals by putrefaction, consist of fixed and animal hepatic, mixed with a very small proportion of phlogisticated air *.

* It may be proper to remark, that I have obtained, by distillation from the green leaves of a cabbage, an aërial fluid, which, in most of its properties, resembles animal hepatic air.

Of

Of the effects produced by exposing fresh animal substances to atmospherical, hepatic, and pure air.

Two tubes, of nearly the same size, were inverted over mercury. Into one of these was introduced common air, and into the other an equal bulk of hepatic air, obtained from liver of sulphur by the vitriolic acid. Equal quantities of fresh veal, consisting of a mixture of muscular fibres and of fat, and weighing each one dram, were then exposed to these airs. At the end of three days the piece that was in contact with the common air had not altered its colour or consistence, but smelled a little putrid. The colour of the fatty parts of the piece that was exposed to the hepatic air was changed to a dark green, the muscular fibres were cracked and shrivelled on the surface as if they had been seared with a hot iron, and the whole had acquired a soft consistence.

Similar trials were made with two pieces of fresh veal, one of which was exposed over mercury to common air, and the other to air extricated from putrid veal by distillation. The former in three days had not changed its appearance; the latter had become green round the edges, and was interspersed with green spots. The surface of the mercury in the jar which contained the last had acquired a brown colour; whereas that of the mercury in the jar which contained the common air was clear and bright. The pieces of veal were suffered to remain in this situation for six weeks. After a few days had expired, *that* which was exposed to the animal air did not appear to suffer any farther change. Its colour, which in the course of a week had become brown, continued unaltered, and no dissolution took place. The air at the last was very fetid; it occa-
sioned

fioned a copious precipitate in lime-water; it was highly in-
flammable, and burned with a blue lambent flame.

The piece, on the contrary, which was expofed to the com-
mon air, did not, as has been already obferved, fo foon lofe its
fibrous texture, nor fo fpeedily acquire a dark colour, as that
which was in contact with the animal air. But the progrefs
of its putrefaction did not appear to ftop at the end of a few
days, as in the latter inftance. It advanced flowly, and at the
expiration of fix weeks a confiderable part of the 'mufcular
fibres had run down to a brown liquid. The air in which it
was placed now occafioned a copious precipitation in lime-
water, and the brown liquid was found to be impregnated with
animal hepatic and fixed air; the exiftence of the latter being
known by means of lime-water, and that of the former by
its occafioning a dark precipitate in a folution of nitrated filver,
as well as by its fetid odour, which was increafed by the vitri-
olic, and deftroyed by the concentrated nitrous and dephlogifti-
cated marine acids.

The following experiment was made with a view to deter-
mine whether pure air accelerates the progrefs of putrefaction
in animal fubftances.

In the month of December, 1789, equal portions of pure
and of common air were introduced into two equal jars over
mercury, in each of which was placed about two drams of
frefh beef. At the end of a week, the beef which was expofed to
the pure air had become highly putrid; but very little change
was produced in that which was expofed to the common air.

The facts which have been afcertained by the preceding
experiments, appear to lead to the following conclufions refpect-
ing the procefs of putrefaction in the lean of animal fub-
ftances.

The

The mufcular fibres of animals contain fixed and phlogifti-cated air, the inflammable principle in the ftate of heavy and of light inflammable air, and a fubftance which, by means of heat or of putrefaction, is capable of being converted into animal hepatic air *. When the mufcular fibre, after the death of the animal, is expofed to the pure air of the atmo-fphere; the latter, by a fuperior attraction, combining with the heavy inflammable air, produces fixed air, and at the fame time furnifhes the quantity of heat neceffary to the formation of animal hepatic air. The cohefion of the fibre being thus de-ftroyed, the fixed, as well as the light inflammable and phlo-gifticated air, which enter into its compofition, are difengaged, and the two latter fluids uniting with each other produce the volatile alkali.

The alterations which take place in putrefaction are in moft refpects fimilar to thofe which arife from deftructive diftilla-tion. By expofure to heat the fixed air of the animal fibre is extricated, hepatic air and volatile alkali are produced, and the inflammable principle not coming into contact with the pure air of the atmofphere, is raifed in the form of heavy inflam-mable air.

I have found, that the fetid odour of animal hepatic air is deftroyed by mixing it with pure air, and fuffering it to remain in contact with that fluid for feveral weeks. When it was placed in this fituation, it acquired an odour which was not exactly fimilar to any that I had ever before perceived, but which bore fome refemblance to that of inflammable air ob-tained by diffolving iron in fpirit of vitriol.

* It is fcarcely neceffary to obferve, that the exiftence of fixed, inflammable, and phlogifticated air in animal fubftances, and the compofition of volatile alkali, were difcovered before I began to give particular attention to this fubject.

I   The

The peculiar fmell of animal hepatic air is likewife de-
ftroyed by agitating it with vinegar, or with the concentrated
vitriolic acid. But the fluids which moft fpeedily produce this
effect, are the concentrated nitrous and dephlogifticated marine
acids; and thefe fluids are known to abound with pure air. It is
therefore extremely probable, that this alteration depends upon
an union between the pure air of the latter fubftances and the
animal hepatic air, or fome of its conftituent parts.

It appears from the experiments which have been recited
above, that in cancerous and other malignant ulcers, the ani-
mal fibres undergo nearly the fame changes which are produced
in them by putrefaction, or by deftructive diftillation. The
purulent matter prepared for the purpofe of healing the ulcer
is, in fuch cafes, mixed with animal hepatic air and volatile
alkali. The compound formed by the union of thefe fub-
ftances, which may perhaps not improperly be termed hepa-
tifed ammonia, decompofes metallic falts, and acts upon me-
tals: for we have feen, that when it was placed in a jar over
mercury for feveral days, the furface of the mercury acquired
a black colour; and that it inftantly occafioned a dark precipi-
tate in a folution of nitrated filver. Thefe facts feem to afford
an explanation of the changes produced in metallic falts, when
they are applied to malignant ulcers. The volatile alkali com-
bines with the acid of the metallic falt, and the animal hepa-
tic air revives the metal, either by imparting to it the inflam-
mable principle, or by uniting with the pure air which the
calx is fuppofed to contain. The metal, thus revived, is pro-
bably in fome cafes again corroded by the hepatifed ammonia,
which communicates to it a black colour. Thus we may
account for the dark incruftation frequently formed upon the
<div align="right">tongue</div>

tongue and internal fauces, when venereal ulcers of the throat are wafhed with a folution of corrofive fublimate. And hence alfo the dark tinge which is frequently communicated by ill-conditioned ulcers to poultices made with a folution of fugar of lead. The action of the hepatifed ammonia likewife explains the reafon why the probes are frequently corroded when they are introduced into finuous ulcers, or applied to the furfaces of carious bones. To the fame caufe it is probably owing, that polifhed metallic veffels are quickly tarnifhed, when they are expofed to the effluvia of putrid animal fubftances.

From the foregoing experiments it moreover appears, that animal hepatic air imparts to the fat of animals recently killed a green colour; that it renders the mufcular fibres foft and flaccid, and increafes the tendency to putrefaction. It is there-fore a feptic principle; and hence it is extremely probable, that the compound of this fluid with volatile alkali, which is found in the matter difcharged by the open cancer, produces dele-terious effects: for although the mifchief in cancerous ulcers feems principally to depend upon a morbid action of the vef-fels, whence the unhealthy ftate of the matter difcharged by fuch ulcers is fuppofed to derive its origin, yet from the cor-rofion of the coats of the larger blood-veffels, and the obftruc-tions in the contiguous glands, there can be little doubt that this matter aggravates the difeafe. The experiments recited above appear to prove, that the hepatifed ammonia is the in-gredient which communicates to the cancerous matter its putrid fmell, its greater thinnefs, and, in a word, all the peculiar properties by which it differs from healthy pus.

From thefe confiderations it was inferred, that a medicine which would decompofe the hepatifed ammonia, and deftroy the fetor of the animal hepatic air, without at the fame time

increafing

increafing the morbid action of the veffels, would be productive of falutary effects. The nitrous acid does not deftroy the fetor of hepatic air, unlefs it be highly concentrated; and in this ftate it is well known that it fpeedily corrodes animal fub-ftances. But the fetor of hepatic air quickly difappears when it is mixed with the dephlogifticated marine acid, even though the latter be fo much diluted with water as to render it a very mild application. I have found that this acid, diluted with thrice its weight of water, gives but little pain when it is applied to ulcers that are not very irritable; and in feveral cafes of cancer it appeared to correct the fetor, and to produce a thicker and more healthy pus. It is proper, however, to remark, that other cafes occurred in which it did not feem to be attended with the fame falutary effects. Indeed, fome can-cerous ulcers are fo extremely irritable, that applications which are at all of a ftimulating nature cannot be ventured upon with fafety. And hence if the obfervations, which I have made on the efficacy of this acid as an external application, fhould be confirmed by future experience, it muft be left to the judge-ment of the furgeon to determine both the degree of its dilution, and the cafes in which it may be employed with advantage.

The dephlogifticated marine acid, as is generally known, has the power of deftroying the colour, the fmell, and per-haps the tafte, of the greater part of animal and vegetable fubftances. We have feen that it corrects the fetor of putrid flefh. And I have found, that, when it is poured in fufficient quantity upon hemlock and opium, thefe narcotics fpeedily lofe their fenfible qualities. As it appears, therefore, to poffefs the power of correcting the vegetable, and probably many of the animal poifons, it feemed not unlikely, that it might be ufeful as an internal medicine. Conceiving that its exhibition

would be perfectly fafe, I once took twenty drops of it diluted with water. I foon afterwards, however, felt an obtufe pain, with a fenfe of conftriction, in my ftomach and bowels. This uneafinefs, notwithftanding the ufe of emetics and laxatives, lafted for feveral days, and was at length removed by drinking water impregnated with fulphureous hepatic air. I afterwards found, that the manganefe, which had been ufed in the diftillation of the acid, contained a fmall portion of lead.

Dr. INGEN-HOUSZ informed me, that a Dutchman of his acquaintance, fome time ago, drank a confiderable quantity of the dephlogifticated marine acid : the effects which it produced were fo extremely violent, that he narrowly efcaped with his life. If therefore this acid fhould hereafter be employed as an internal medicine, it would be neceffary to prepare it by means of manganefe that has been previoufly feparated, by a chemical procefs, from the lead and the other metals with which that fubftance is ufually contaminated.