

An account of the experiment made at the desire of the Lords Commissioners of the Admiralty on board the Union Hospital Ship, to determine the effect of the nitrous acid in destroying contagion .. : in a letter addressed to the Right Hon. Earl Spencer.

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AN
ACCOUNT
OF THE
EXPERIMENT

MADE AT THE DESIRE OF THE
LORDS COMMISSIONERS of the ADMIRALTY,
ON BOARD THE

UNION HOSPITAL SHIP,

TO DETERMINE THE EFFECT OF THE
NITROUS ACID IN DESTROYING CONTAGION,
AND THE SAFETY WITH WHICH IT MAY BE EMPLOYED,

IN A LETTER ADDRESSED TO
THE RIGHT HON. EARL SPENCER,
Esq. Esq. Esq.

BY

JAMES CARMICHAEL SMYTH, M. D. F. R. S.,
FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS,
AND
PHYSICIAN EXTRAORDINARY TO HIS MAJESTY.

PUBLISHED WITH THE APPROBATION OF THE LORDS
COMMISSIONERS OF THE ADMIRALTY,

LONDON:

PRINTED FOR J. JOHNSON, IN ST. PAUL'S CHURCH-YARD,

1796.

AN
A C C O U N T
OF THE
EXPERIMENT

MADE AT THE DESIRE OF THE
LORDS COMMISSIONERS WITH ADMIRALTY

UNION, HOSPITAL SHIP

TO DETERMINE THE VALUE OF THE
AMOUNT AND IN DEPENDENT ON THE
AND THE SAFETY WITH WHICH IT MAY BE
IS A LETTER ADDRESSED TO

THE RIGHT HON. HARRIS BURKE
ON THE

JAMES GARRISONAL SMITH
OF THE

WITH THE

L O N D O N
PRINTED BY

THE RIGHT HONOURABLE

E A R L S P E N C E R,

Es. Es. Es.

MY LORD,

THE general opinion entertained of your Lordship, in the high department, at the head of which you are placed, is the only apology I can offer for having taken the liberty to trouble you on the subject of my late publication. The immediate attention paid to this by your Lordship, and by the rest of the Lords Commissioners of

the Admiralty, is extremely flattering to me, as an individual, and claims my warmest gratitude ; but it is of much more importance, my Lord, as holding out to the nation, a well grounded confidence, that no object which may be conducive to the public service, or to the preservation of those brave men, the pride and protectors of their country, can long escape your Lordship's notice. I have now the honor to lay before you, and the rest of the Lords Commissioners of the Admiralty, an account of the Experiment made on board the Union, at your Lordship's desire, and likewise of those trials that were made at the desire of the Russian Admiral, and with your Lordship's approbation, on board some ships of his squadron. I consider myself, in executing this task, as only per-
forming

forming a duty I owe to your Lordship, and which I do with the greater pleasure, as it may possibly be the means of making public a discovery which should be universally known; and as the only way in my power to bring forward the merit of those Gentlemen, to whose assistance I have been particularly indebted for the fortunate issue of this experiment, and from whose reports I am enabled to present your Lordship with an account of the manner in which it was conducted, and of the particular effects it produced.

Mr. Menzies, late Surgeon to his Majesty's sloop the Discovery, was the person who, at my request, very obligingly undertook the management of the experiment on board the Union, and it is but doing

him justice to say that I could not have found a gentleman better qualified, in every respect, for executing so important a trust. I shall therefore, my Lord, without farther preface, lay before you, and the rest of their Lordships, Mr. Menzies's journal, as affording a better description of the experiment, so long as he continued to conduct it, than any I can offer.

REPORT

REPORT
OF THE
EXPERIMENT
FOR

Stopping the Progress of Contagion, as executed on board the Union Hospital Ship, at Sheerness, by Mr. Arch. Menzies.

DOCTOR James Carmichael Smyth having been requested, by the Lords Commissioners of the Admiralty, to send a person on board the Union Hospital Ship, laying at Sheerness, to make trial of the effect of a fumigation of the Nitrous Acid,

and of other means recommended by him in a late publication, for destroying Contagion, I readily engaged, upon application being made to me by some of our common friends, in the execution of an experiment which I foresaw might eventually be of much benefit to society, and particularly to that service, to which I have the honor to belong.

After having, therefore, received instructions, and obtained every necessary information on the manner of conducting the fumigation, I left London on the 24th of November, 1795, and arrived at Sheerness the same evening.

Next morning I waited on Admiral Buckner, the commanding officer of the port, whose politeness and zeal to promote the object of my journey, were equally conspicuous, and deserves my most grateful acknowledgment.

I afterwards went on board the Union, where I produced the orders of the Admiralty

falty to Lieutenant Quarme, the commanding officer, and Mr. Bassan, surgeon of the ship, who received me with cordiality, and readily offered every assistance in their power to carry on the experiment, upon the event of which not only the safety of the ship's company, but, perhaps, their own, in great measure, depended.

On examining the state of the hospital, I plainly foresaw that fresh contagion would be daily pouring into it from the Russian vessels, under which disadvantageous circumstance, it would be difficult to decide on the success of our endeavours. The lower and middle gun-decks were divided into large apartments, or wards, by cross partitions, with a free communication between each*: they were extremely crowded, and the sick of every description lay in cradles, promiscuously arranged, to the number of nearly two hundred; of which about one

* To give a more exact idea, I refer to the drawing of the ship which accompanies this journal.

hundred and fifty were in different stages of a malignant fever, extremely contagious, as appeared evident from its rapid progress, and fatal effects, amongst the attendants on the sick, and the ship's company. For, from the beginning of September last, when the Russian sick were first admitted into the hospital; eight nurses and two washer-women had been attacked with this fever, and of these three had died. About twenty-four of the ship's company had likewise been ill of the same disorder, and of these a surgeon's mate and two marines died. Upon the whole, however, the mortality had not been so great as there were reasons to dread, from the virulence of the contagion, and malignity of the disease; which can only be ascribed to the great care and attention of Mr. Bassan, surgeon to the hospital, whose conduct in so critical a situation does him the highest honor, and reflects lustre on his professional abilities, in the faithful discharge of so unpleasant a duty.

After I returned on shore from the Union, I employed the rest of the day in collecting and sending on board such utensils and materials as were required for fumi-gating the ship; these consisted of a quantity of fine sand, about two dozen quart earthen pipkins, and as many small common tea cups, together with some long slips of glass to be used as spatulas; the other materials I had brought with me from town, viz. the concentrated vitriolic acid, and a quantity of pure nitre in powder.

On the forenoon of the twenty-sixth I went again on board the Union. I first ordered all the ports and scuttles to be close shut up; the sand, which had been previously heated in iron pots, was then scooped out into the pipkins by means of an iron ladle, and in this heated sand, in each pipkin, a small tea cup was immersed, containing about half an ounce of concentrated vitriolic acid, to which, after it had ac-
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quired a proper degree of heat, an equal quantity of pure nitre in powder was gradually added, and the mixture stirred with a glass spatula, until the vapour arose from it in considerable quantity. The pipkins were then carried through the wards, by the nurses and convalescents, who kept walking about with them in their hands, occasionally putting them under the cradles of the sick, and in every corner where any foul air was suspected to lodge. In this manner we continued fumigating, until the whole space between decks was, fore and aft, filled with the vapour, which appeared like a thick haze.

I however proceeded in this first trial slowly and cautiously, following with my eyes the pipkins in every direction, to watch the effect of the vapour on the sick, and observed that at first it excited a good deal of coughing, but which gradually ceased, in proportion as it became more generally diffused through the wards; this
effect

effect appeared indeed to be chiefly occasioned by the ignorance or inattention of those who carried the pipkins, in putting them sometimes too near to the faces of the sick, by which means they suddenly inhaled the strong vapour, as it immediately issued from the cups.

In compliance with Doctor Smyth's request, the body-clothes and bed-clothes of the sick were, as much as possible, exposed to the nitrous vapour during the fumigation; and all the dirty linen removed from them was immediately immersed in a tub of cold water, afterwards carried on deck, rinsed out, and hung up till nearly dry, and then fumigated before it was taken to the wash-house: a precaution extremely necessary in every infectious disorder. Due attention was also paid to cleanliness and ventilation.

As the people were at first very awkward and slow, it took us about three hours to fumigate the ship; in about an hour
after,

after, the vapour having entirely subsided, the ports and scuttles were thrown open, for the admission of fresh air. I then walked through the wards, and plainly perceived that the air of the hospital was greatly sweetened, even by this first fumigation.

Next morning the ship was again fumigated, beginning with the lower deck, and the people employed, being now better acquainted with the operation, were more expert, and finished the whole in about an hour's time ; in an hour afterwards, the vapour having entirely subsided, the fresh air was freely admitted into the hospital.

This day the sand was made hotter, and the fumigation was of course much stronger, yet the patients suffered no other inconvenience from it, than a little coughing, and even that was not near so general as the day before.

Twelve pipkins were found sufficient for fumigating the lower deck, ten for the middle gun deck, two for the ship's company's bed-room, two for the marines bed-room, and one for the washing place; in all twenty-seven pipkins. Consequently, about fourteen ounces of the vitriolic acid, and as much nitre, was expended in the forenoon; but, in the evening, as every place was so close, and the fresh air could not be afterwards so freely admitted, it was not thought necessary to employ so many pipkins; so that little more than half the quantity of the fumigating materials, used in the morning, was generally found sufficient for the evening's fumigation.

The pleasing and immediate effect of the fumigation, in destroying the offensive and disagreeable smell arising from so many sick crowded together, was now very perceptible, even to the nurses and attendants. The consequence of which was, that they now began to place some degree
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of confidence in its efficacy, and approached the cradles of the infected with less dread of being attacked with the disorder ; so that the sick were better attended, and the duty of the hospital was more regularly, and more cheerfully, performed. In short, a pleasing gleam of hope seemed now to cast its cheering influence, over that general despondency which was before evidently pictured in every countenance, from the dread and horror each individual naturally entertained of being, perhaps, the next victim to the malignant powers of a virulent contagion.

On the twenty-eighth, the fumigation was repeated morning and evening, in the same manner as on the preceding day, and with the same pleasing effect, destroying the offensive smell, and purifying the general air of the hospital. But there was, in particular places, a constant source of bad smell, which was not easily overcome, and which was occasioned by the *necessaries*.

These

These were badly constructed, being placed within the ship, to the number of seven on the lower deck, and two on the middle deck, with small funnels that pierced the sides of the ship in a slanting direction, and generally retained the *soil*, unless where a person constantly attended to wash it away, a very troublesome and dangerous office, which chiefly fell to the lot of the nurses, and doubtless tended to spread the contagion amongst them.

I mentioned this nuisance to the commanding officer, who told me that he viewed them in the same light, and that some alterations were making, which he hoped would remedy the evil. I therefore waited a few days the event of these alterations before I should make any public report on the subject.

For the following eight days I continued the fumigation on board the Union, regularly morning and evening, as already described, without observing any particular

occurrence different from what is already related, only that during this time, a considerable number of patients having been discharged from the hospital, all the spare cradles were ordered on deck, to be scrubbed and washed with the diluted marine acid, according to the particular directions of Dr. Smyth.

On the seventh of December, I resigned to Mr. Bassan the further prosecution of the experiment on board the Union hospital ship, but before I leave her, I must say, that it has already produced the most evident and beneficial effects, as not one of the attendants on the sick, nor any of the ship's company have been attacked with the disorder since I began the fumigation, with the exception of one nurse, who suffered a slight relapse from some imprudence; an accident which Mr. Bassan informs me was very frequent in the beginning. And as none of the sick, who have been brought to the hospital since my arrival, have died,
it

it would seem that the fumigation has not only lessened the danger of infection, but also the malignity of the disease.

The process of fumigating, as already described, with the *nitrous acid*, is simple and easy, and although the vapour is extremely powerful and penetrating, the sick of every description were observed to bear it, with little or no apparent inconvenience, and to a much higher degree than I could have expected; and as it is found to purify the air from the disagreeable effluvia, produced by so many people crowded together in a confined situation, it will be peculiarly advantageous on board of sickly ships, where the crew, their clothes, and the ship, may be fumigated at the same time without any risk from fire.

December 16, 1795.

On the sixteenth of December, I again visited the Union hospital ship, and found that the fumigation had been hitherto car-

ried on regularly twice a day, and with the same evident advantages, in purifying the air of the hospital, and lessening the malignity of the disorder, so that every nurse and attendant on the sick, went now cheerfully and confidently about their duty; without the least dread or apprehension of the contagion, by which means the sick were better taken care of, and the general state of the hospital was in a much more prosperous way. It was therefore, from this time, deemed sufficient to fumigate only once a day.

December 23, 1795.

On visiting the Union again on the twenty-third of December, I found the carpenters employed, from the dock yard, in making the alterations which I formerly proposed in a letter to Dr. Carmichael Smyth, respecting the *necessaries*, and which I was happy to find, the Lords of the Admiralty had ordered to be done upon his application.

My

My propofal was to remove all the *necessaries* from the infide, and have them rebuilt on the outside of the ſhip, and by cutting down the lower edge of the ſame number of port-holes, to form entrances into them from the hoſpital, by which they would be equally eaſy of acceſs to the ſick, and the nuifance would be totally removed. This I was happy to find the carpenters were now executing, and I am confident it will be attended with beneficial effects, by rendering the hoſpital much ſweeter, and conſequently more agreeable and healthy, both to the ſick and attendants.

ARCHIBALD MENZIES.

Mr. Menzies, as is already mentioned in his Journal, having, on the 7th of December, reſigned to Mr. Baſſan, ſurgeon of the Union, the management of the experiment, I muſt refer your Lordſhip, for the further detail of this buſineſs, to extracts taken

from his letters, some of which you have already seen, and which are now arranged according to the order of time in which they were written.

Mr. Baffan's conduct, my Lord, through the whole of this business, does him the highest honor, and cannot fail to recommend him to your Lordship's notice. When the contagion at first began to spread among the ship's company of the Union, he was importuned, by the warrant officers and others, to send them on shore to sick quarters, which he peremptorily refused, saying, with the true spirit of a British sailor: "It is better we should all perish, than have such a contagious fever as this disseminated in our fleet." He accordingly made application to the Commander in Chief, and not a man was sent out of the ship. His humanity and care of the sick, Mr. Menzies mentions in the warmest terms of praise, and his successful treatment of them, is the best testimony

of

of his professional abilities. His zeal and attention, in conducting the experiment, I shall always recollect with gratitude. He and Mr. Menzies were both of them strangers to me until this occasion brought us acquainted; but I must say, that in the whole circle of my acquaintance, I could not have found two more liberal or candid men.

*Extracts of Mr. Bassan's Letters to Dr.
Carmichael Smyth.*

Sheerness, December 4.

I beg leave to inform you, that we have continued to fumigate, in the manner directed, daily; and as only one Russian has died since we began, I consider that circumstance as an early prospect of our future success.

— *December 9.*

We continue to fumigate the ship as formerly ; your other instructions shall be punctually adhered to.

— *December 11.*

I yesterday sent you two lists or journals, one of the Russian sick, and the other of persons belonging to the Union, who have been attacked with the fever ; from the last you will perceive that very few days elapsed from the first importation of the disease, to the 26th ult. without some one or other of the attendants, or ship's company, being seized with it ; but since that period not one has been taken ill. I intend, very shortly, to send you a brief account of the disease, the symptoms of which are at present much meliorated. I believe that the fumigation has been of great service to the sick. We have very few patients at present

sent who are not in a convalescent state, and there is every prospect that, through your assistance, we shall soon become a wholesome ship.

— *December 15.*

Since my last of the 11th inst. I have received eighteen patients with the fever, none of which have died, although some of them were brought to the hospital in a state of the utmost danger. The utility of the fumigation appears now very evident, as, notwithstanding the great number of fever patients brought into this hospital ship, not one of the attendants, or ship's company, have experienced the slightest indisposition since we first began to employ it.—A very satisfactory demonstration of its power in destroying contagion; indeed, Sir, I most sincerely congratulate you on the success of a discovery, which promises to be of such eminent service to society. Believe me, every thing shall be done, on

my part, agreeably to your directions, to give it its full effect.

— *December 19.*

The fumigation continues to demonstrate its efficacy, as all the attendants, and ship's company, continue to enjoy perfect health, notwithstanding I have lately received some patients with the contagious fever in as bad a state as any I have seen; nor has a new nurse, or any of the workmen, who are daily employed in the hospital making the proposed alteration of the necessaries, suffered the slightest attack of the disease.—Mr. Menzies goes on with the Russian ships, from which I hope soon to find the infection totally extinguished.

— *December 21.*

I am happy to inform you, that the contagion on board this ship appears to be nearly at an end, no one either of the attendants on the sick, or of the ship's company,

pany, having been attacked with the fever since we began to fumigate, notwithstanding we have received some patients in as bad a state of fever, since that time, as any from the first importation of the disease. The people bear it exceedingly well, and I frequently stand in the midst of a cloud, arising from the fumigation, as thick as a fog, without the smallest inconvenience, a circumstance of great consequence, as the sick are all in the wards during the fumigation, and their clothes, &c. are consequently impregnated with the acid vapour. In a few days we shall be able to ascertain the success on board the *Pamet Eustaphia*, the only ship at this port in which the fever at present seems to prevail to any degree. I shall then consider the experiment as compleat, and shall congratulate you on the success of an invention, that, in all probability, will give you immortal honor, and which, from its public utility, you will so highly merit.

— De-

— December 30.

Since my last, one nurse and one marine have been taken ill of the fever, although the symptoms are evidently milder than heretofore. As it is impossible to say how long contagion may remain in an infected person before it is put into action, I am not at all discouraged by these two cases; but shall continue every exertion in my power, in prosecuting the experiment, which has already been of such eminent utility. I have received several patients from the St. Alexander Niewski, and another Russian ship, returned from sea, five or six of them ill of the fever. I need hardly observe, that if you could by any means enforce the fumigating all the Russian ships, as well as enjoin cleanliness, it would be of the utmost consequence; and if you can send any person to aid me in the business, I should be very glad; for though Mr. Menzies so strongly recommended,

mended, to the Commanders, the necessity of continuing the fumigation, not one at Sheerness has made application to me for any materials for that purpose.

*Extract of a Letter from Mr. Bassan to
Mr. Menzies.*

Sheerness, December 30.

The Russian ships which arrived this week from sea, are sickly. I received several with the petæchial fever, as bad as any I have seen; and am sorry to say that nurse Murray has had a slight attack, and one of the marines is at present ill of the same fever. He was taken ill on Tuesday morning, the symptoms are not so violent as formerly, and I shall double my attention in prosecuting the experiment which has already been of so much use.

To

TO DR. CARMICHAEL SMYTH.

Sheerness, January 4.

I cannot account for the contagion having produced the effects on the people mentioned in my last, otherwise than from the fumigation having been used the preceding week, only once a day, or from their having been infected prior to the commencement of it, which I think is not impossible. I am now determined to use it constantly twice a day, and have done so since Tuesday last, the day on which the marine was attacked; besides, exclusive of the general fumigation, I place a fumigating pot or two in the wards near the worst of the fever patients. The sick not only bear the fumigation exceedingly well, but aid us voluntarily every day, the convalescents carrying the pipkins about, and expressing

pressing their conviction of its keeping the wards sweet, which certainly it does, and those persons who have hitherto escaped infection, are so much convinced of its efficacy, and have so much faith in its power, that I should find it difficult to discontinue the use of it, whilst there is a sick man on board. As a week has now elapsed since any person has been attacked with the disease, notwithstanding we daily receive patients in the same putrid petæchial fever, from the ship's lately arrived from sea, I have every reason to expect our being once more a wholesome ship. Be assured, Sir, that no pains shall be spared, on my part, to accomplish so desirable an object.

— *January 7.*

I am happy to inform you that no person has been attacked with the putrid fever since my last, though we have received several sick from the Russian ships lately arrived from sea.

January

— *January 13.*

I am happy to acquaint you, that since we began again to fumigate the ship twice a day, no one has been attacked with the fever, although there are several carpenters at work in altering the necessaries, which are nearly compleated on the lower gun deck, and are to be altered immediately on the other deck.

I saw Captain Senevin, Commander of the Pamet Eustaphia, the day before yesterday, who informed me that he had continued the fumigation every day since Mr. Menzies's departure, and that he had now no sick on board.

— *February 3.*

I have the pleasure to inform you, that the contagion seems now to be totally extinct, no one having been attacked with the fever since the 26th of December last,
and

and only two since the 26th of November, the time when the fumigation was begun; one of these a marine, who, ten days previous to his being taken ill, had constantly drank very hard, and was often drunk; the other a nurse, who was very slightly attacked, and both, in my opinion, might have received the infection long before it was put into action, as from their duty they were constantly exposed to the contagion when it was first brought into the ship; and this is rendered still more probable, as there have been several artificers at work, making the alteration in the privies, and of course amongst the sick, and likewise a fresh nurse, a young woman immediately employed in the fever ward, none of whom have received the smallest injury. I therefore now consider the experiment as compleat, and can bring sufficient evidence to convince any one that the contagion in the hospital, on board the Union, has, through Divine providence, been destroyed

by the fumigation you recommended: besides, as the acid vapour keeps the ship sweet, it is my intention to continue it for that purpose constantly, if I am permitted so to do. The sick bear it perfectly well, and, from its power in destroying alkaline vapour, it renders the air pure, and consequently grateful both to the sick and convalescents, as well as to those whose duty it is to attend them. I most sincerely congratulate you on the success of this business,

And am,

Sir, &c.

A. BASSAN.

To

To the preceding account of the experiment on board the Union, I shall take the liberty, my Lord, to subjoin a brief description of the trials made, at the request of the Russian admiral, and with the approbation of your Lordship, on board some ships of that squadron: and here I must again refer you to Mr. Menzies's journal.

REPORT
OF THE
EXPERIMENT

FOR

Stopping the Progress of Contagion, as executed on board some of the Russian Men of War, by Mr. Arch. Menzies.

SOON after my arrival at Sheerness, I had the honor of being introduced to his Excellency Admiral Hannikow, Commander of the Russian Squadron at that port, on which occasion he was pleased to express a particular desire of having the most sickly ships

ships of his Squadron purified, by the same process of fumigation, as I was then carrying on, on board the Union hospital ship. This being made known to the Lords Commissioners of the Admiralty, they were pleased to declare their approbation, by requesting Admiral Buckner to confer with his Excellency on this subject: and on the twenty-eighth of November, it was agreed between these Commanders, that the fumigation should be tried, under my directions, on board such of the Russian vessels as were then most infected with the contagious fever, which had already proved so fatal to many of their crews; and it is but justice to say, that his Excellency, on this occasion, shewed a particular zeal for its success, by offering me every aid and assistance, and by assuring me of a ready compliance, with every means that might be suggested to accomplish so desirable an object, as the health and preservation of those under his command. But it

so happened, that, on the day following, he was ordered, with part of his squadron, to the North Seas, and in this state of hurry, not having time to consider which was the most sickly vessel, he left orders for the trial to be made on board the Revel frigate; but on examining the hospital books on board the Union, the Pamet Eustaphia, of 74 guns, appeared to claim our first attention, from her sickly state: I therefore waited on Admiral Buckner, to acquaint him with this circumstance, and he very readily applied to Capt. Chechagoff, on whom the command of the remaining part of the Russian squadron had devolved, and obtained his leave for the trial to be made on board of her, in preference to the other. After this, some unavoidable delay was occasioned, in waiting for the materials, and collecting together the utensils necessary for the operation.

In the forenoon of the seventh of December, 1795, I went on board the Pamet Eustaphia,

Eustaphia, and having ordered the ports, scuttles, and hatchways to be close shut up, with the ship's company between decks, we fumigated her for the first time, and continued it morning and evening on the following day, in the same manner that we had done the Union hospital ship.

This ship has of late sent more sick with the malignant fever to the hospital, than all the rest taken together, of the Russian squadron laying at this port, which her Commander, Capt. Sinavin, attributes in a great measure to her shingle ballast being chiefly composed of sand, intermixed with a large portion of wet earth, that keeps up a constant moisture and dampness below, in spite of every means of ventilation: add to this the putrid stench, arising in so close and crowded a situation from the *shubs* or sheep-skin great-coats, which are generally wore by the Russian seamen, with the woolly side next their body, and which undoubtedly must aid to nourish

the seeds of contagion, and increase its virulence.

I represented to several of the Commanders of the Russian men of war, the necessity there was of destroying, or at least of suppressing these *shubs* in this country, for though they might be very comfortable, and answer pretty well in dry, cold, frosty weather, such as is generally the case in the long winters in Russia, yet they were by no means calculated for the chilly wet weather which generally prevailed in this country; as in a damp state they never fail to impregnate the air with offensive putrid effluvia, that must be extremely hurtful to peoples constitution where it is constantly breathed by so many crowded together in such a confined situation.

Early on the morning of the ninth, the Pamet Eustaphia, with the Ratvezan of 66 guns, were removed up to Chatham, in consequence of which it was not in my power to continue the fumigation, though

I went

I went there on purpose. And on the following day, the crew was so busily occupied, in unrigging the ship, and clearing her of stores and provision, to prepare her for going into dock, that no time could be spared to attend to the fumigation, until that duty was accomplished; which as it would take up some days, and as her people were then to be put on board a receiving ship, while she was in dock, (a circumstance I considered as very unfavourable to the experiment) I therefore came to London on the eleventh, to consult with Doctor Carmichael Smyth, what plan was best to pursue; for as this was the only Russian vessel from which a fair estimate could be drawn of the utility and efficacy of the fumigation, I was anxious to continue it, in whatever manner might be thought most likely to secure success in destroying the contagion, or lessening its malignity.

I re-

I returned to Chatham again on the fourteenth, with orders to fumigate as many of the Russian vessels, especially such as were most sickly, as I possibly could; for though the experiment could not be regularly carried on, yet in this manner it might lessen the virulence of the disorder, and diminish the number of sick sent to the hospital.

Next day I waited on Capt. Chechagoff and Capt. Sinavin, and found that their vessels were not yet cleared of their stores, &c. so that I could not go on with either. Indeed, the *Ratvezan* was pretty healthy, her Commander, Capt. Chechagoff, being very attentive to every means of purifying his vessel by ventilation and cleanliness, and by destroying and suppressing the *shubs*, as far as he possibly could; for he told me, he could not do them away altogether, without giving the men other cloathing *in lieu*, which must be done by an order from the Commander in Chief.

Captain

Captain Chechagoff also informed me, that the Pimen, of 66 guns, was arrived at Sheerness, which had, some time ago, been so very sickly, that boats from other vessels were forbid coming along-side of her, from a dread of the infection; he therefore expressed his desire of having her well fumigated; and I immediately set out to execute his request.

On the sixteenth of December, I fumigated the Pimen, for the first time. Her crew, however, was nowise sickly now, although on visiting her between deck, before the fumigation, the stench produced by the *shubs* was very perceptible, and extremely offensive; and it was pleasing to observe the sudden change produced by the powers of the nitrous vapour in destroying it.

When I went on board, on the following day, to continue the fumigation, I found the officers and crew attending Divine Service, and the Priests sprinkling the decks with Holy-water, so I did not intrude; but

but left orders, with their own Surgeon, to fumigate the ship in the evening, if he could conveniently, which he did. As this was a holiday amongst them, I also declined calling on board the Revel frigate till the next day, when, after fumigating the Pimen, I went on board the Revel, to request them to prepare for fumigating her. On visiting this vessel between decks, I found the putrid stench from the *shubs* extremely offensive and disagreeable from the confined air, and want of ventilation; and I had great difficulty to make myself understood, or give any particular directions for want of an interpreter.

The nineteenth was so boisterous that I could not get on board either vessel, but the Surgeon of the Pimen was so good as to continue the fumigation as usual. Captain Colokolsoff, the Commander of this vessel, was extremely civil, and well disposed to promote my endeavours; and the principal officers were equally polite and
 ready

ready to see my directions executed on all occasions.

Next day I visited the Pimen, which was now quite free from stench or any offensive smell, in consequence of the fumigation having been regularly continued. I also began to fumigate the Revel frigate, and regularly attended both vessels, for the three following days; after which I left the materials and utensils on board them, with directions to their own Surgeons, to continue it in the same way daily.

From what information I could collect, the Revel had not been very sickly, yet the few she had lately sent to the hospital, were malignant fevers, which clearly shewed that the contagion was lurking on board her, though it did not spread with much violence.

Being particularly anxious to resume the experiment on board the Pamet Eustaphia, she being the most sickly, and on that account claiming more particular attention, I came

up to Chatham on the twenty-fourth, and found she had been just hauled into dock, and her crew put on board the Prince Edward receiving ship, where they were very much crouded. On the following day I began the fumigation, but as many of the ports and hatchways of the ship could not be shut close enough to retain the vapour for a sufficient length of time, a quick and strong fumigation became more essentially necessary; which however I could not get them to execute, not being able to make them understand my meaning, for want of a sufficient knowledge of their language.

The fumigation was, notwithstanding, continued regularly on board this ship for the four following days, although it was not in my power to prevail on them to do it sufficiently strong, to do justice to the trial,—and to insure that success we had already experienced on board the Union; their excuse generally was,
that

that the fire was too much occupied to get a sufficient quantity of sand heated.

But, as it was possible, that even this slight fumigation might succeed by long continuance, and as their own Surgeon was now acquainted with the process, and well disposed to carry it on, I left the materials and utensils on board; and, before my departure, waited on Captain Sinavin, who, at this time, lived on shore, and who (after being acquainted with the foregoing circumstances) said that he should order it to be continued while his ships company were anywise sickly.

The Ratvezan having likewise gone into dock; to prevent her crew becoming sickly on board the receiving ship, I, at Captain Chechagoff's particular request, sent utensils and materials on board to be fumigated daily.

Having now put these Russian vessels in a fair train for continuing the fumigation; and finding that my presence, on account of my ignorance of their language,

could not be of any further service; at the same time, some urgent business, of our late voyage, pressing hard upon me, I returned to town on the thirtieth of December, leaving the further prosecution of the experiment, as above related, to be conducted by their own Surgeons; and I have the most pleasing hopes that it will be attended with beneficial effects to her Imperial Majesty's subjects, not only in the present instance, but in every similar situation hereafter.

ARCHIBALD MENZIES.

Having

Having now, my Lord, finished with the account of the experiment given by the two gentlemen who have been employed in conducting it, permit me, before concluding the subject, to call for a moment your Lordships attention to some of the principal circumstances, and to the conclusions which they afford:

In the first place, my Lord, it must be allowed that the present experiment fully justifies all I have said respecting the safety with which the nitrous acid (procured in the manner described) may be employed as a fumigation. No one surely can say that I assume too much, when I consider the safety of the fumigation as established, after a trial of nearly three months, for an hour and a half or two hours, morning and evening, each day, on board an hospital ship, containing from two to three hundred persons of different sexes, and ages, and labouring under different diseases; without a single instance of perma-

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nent inconvenience or bad consequence arising from it: for the slight cough, which it at first excited and which was evidently owing to the awkwardness and ignorance of those who carried the fumigating pipkins, cannot be looked upon as such, and no farther inconvenience has ever been felt by any one on board.

Having established then this important fact, that the nitrous acid is attended with no risk to the health or safety of the people exposed to it, let me next claim your Lordships attention to the sensible and immediate effects of it.

We are told by Mr. Menzies, that after the first fumigation, and still more remarkably after the second, the air of the hospital was perceived to be purer, and free from any putrid or offensive smell: these immediate effects of the fumigation, are likewise repeatedly mentioned by Mr. Baffan, the last of them indeed was too striking not to be taken notice of by every person on board. That the

vapour of the nitrous acid should be found to destroy an offensive smell, the effect of animal exhalations, I was not surpris'd at, having myself had repeated experience of the fact; but that it would also render the air purer and more proper for respiration, I was by no means certain, until I found the repeated observations of those Gentlemen, confirmed by the evidence of Mr. Keir, of Birmingham, one of the first chemists in this country, or perhaps in Europe; an extract of a letter from this gentleman, whom I have not the honor to know personally, to a friend of his in town, I have subjoin'd for your Lordship's satisfaction, as it affords a convincing proof, from chemistry, of the truth of what Mr. Menzies and Mr. Bassan observed in practice. These two qualities, my Lord, viz. the rendering the atmospheric air purer, and consequently fitter for the purposes of animal life, and the compleatly destroying the offensive smell resulting from animal

effluvia or putrid matter, are, of themselves, considerable advantages, if no others were to be expected or derived from the fumigation; but they are of still higher importance, when considered as presumptive evidence of the power of the nitrous vapour to destroy contagion; for whatever is found to destroy the smell of putridity, and at the same time to render the air purer, we must suppose more or less conducive to this grand object. But presumptive evidence, on a subject of this importance, in which the lives of thousands are involved, is not sufficient to satisfy the mind; and, happily for mankind, the present experiment, instituted under your Lordship's auspices, affords compleat and direct evidence of the fact.

But to bring this home to the understanding and conviction of all mankind, it is only necessary to look with attention, at the annexed Hospital Return; for by comparing the state of health of the ship's

com-

company, with the progress and effects of the contagion, before and after the experiment was begun, a clear and decided judgment may be formed of its effects, even by the most ignorant. They will in the first place observe, that from the 3d of September (the day the Russians, ill of the fever, were first brought on board) to the first of October, there were nine persons seized with the distemper, one of whom only belonged to the ship's company; the others were attendants on the sick. That in the month of October, eight persons more were attacked with the disease, and of those three belonged to the ship's company. But, that from the first of November, to the 26th of that month, twelve persons were attacked with the disease, among whom we find eight belonging to the ship's company. From this short statement it is evident, that the contagion which was at first chiefly confined to the hospital, affecting those only who were immediately employed about the

sick, had gradually spread over the ship, and been communicated to the ship's company; by which means the sickness and mortality had increased: and the probability is, that had not a stop been put to it, it would have gone on encreasing in proportion to the diffusion of the contagion, and to the encreasing despondency of the people, who considered themselves as so many devoted victims. The whole number of persons seized with the distemper, during the first three months that it prevailed on board the ship, was 30 (besides six children) which was more than one-third of all the people in the ship, who were only 85, officers included. Of the 30 seized with the fever, eight died of the immediate effects of it, a large proportion surely, being not much less than one in three, and which sufficiently marks the malignity of the distemper.

Having taken a view of the state of the ship's company, and of the progress of the
con-

contagion before the experiment, let us now, my Lord, turn to the other side of the picture, and see what was the situation of things after the fumigation was begun.

On the 26th of November, the ship was fumigated for the first time, and from that day to the 25th of December, not a person on board was attacked with the fever, their despondency was now changed into joy, and their fear into confidence; but as very great confidence is always dangerous, it proved so in the present instance. On the 17th of December, they imagined themselves so secure, that they discontinued the custom of fumigating the ship morning and evening, thinking that once a day was sufficient; the trial, perhaps, was worth hazarding, but on the 25th of December, one of the nurses suffered a slight attack, and on the 26th, a marine, who for a week preceding had been in a state of intoxication, was seized with the fever, of which he died. These two accidents gave immediate

diate alarm ; they returned again to the practice of fumigating twice a day, and from that time to the end of the disorder, there has not been an instance of a person suffering from contagion on board the ship. But the advantage of the fumigation was not felt by the ship's company and attendants alone, whom it preserved from the baneful effects of the fever, the sick and convalescents derived almost an equal benefit from it. The symptoms of the disease (as Mr. Baffan expresses it) were meliorated, and lost much of their malignant appearance, and the advantage of a pure air, and free from stench, to convalescents, may readily be conceived.

From the above relation, my Lord, it plainly appears, that whilst the practice of fumigating the ship twice in the 24 hours was continued, there was no symptom of contagion or of disease, and that the only two accidents which happened from the commencement of the experiment, to the present

present hour, occurred on the 25th and 26th of December, nine or ten days after they had ceased to fumigate the ship, in the manner I had directed. The attack of the nurse, indeed, was but trifling, and I think it not improbable that the fever, as well as the death of the marine, were the consequence of his own intemperance; at any rate, supposing both the one and the other to have suffered from contagion, these cases do not in the least invalidate the general success of the experiment, and only prove, that in a situation where contagion is constantly generated, it requires to be as constantly destroyed; otherwise it is ready at every instant, like the hydra, to rear again its pestilential head.

But, my Lord, the success of the experiment has not been confined to the Union, the power of the nitrous vapour to destroy contagion, has been equally displayed on board those Russian vessels where it has been employed.

Your

Your Lordship must have observed, in Mr. Menzies's journal, the many unexpected delays he met with in the execution of this business. The sudden departure of the Russian Admiral, with a considerable part of the fleet, before the ships, the most proper for the experiment, were fixed upon; Mr. Menzies beginning, in consequence of not being properly informed, with ships where the fumigation was not so immediately necessary; afterwards, when he began to fumigate the Pamet Eustaphia, which had sent more sick to the hospital than any ship of the fleet, she was immediately ordered into dock, and the crew turned over into a receiving ship, a situation extremely disadvantageous for such an experiment: not to mention the various difficulties and obstacles arising from the difference of language, usages, religious ceremonies, &c. sufficient to have discouraged a man of a less firm mind, or who was less zealous, than Mr. Menzies in pursuing his object. He

per-

persevered, however, for some time, but at last was under the necessity of returning to town, and of leaving the farther prosecution of this business to the Russians themselves; and yet, my Lord, owing to the good sense and proper conduct of their officers, who, convinced of the advantage of the fumigation, continued the daily practice of it; those ships that have been fumigated, are free from contagion, and particularly the Pamet Eustaphia which was the most sickly, is now one of the healthiest of the fleet, and has no appearance of contagion on board, nor a man ill of the fever; and so great is the opinion entertained by Admiral Hannicoff, of the efficacy of the fumigation, that he lately sent to town for materials for fumigating some more ships.

Such, my Lord, has been the result of an experiment, by which some lives have been already saved, and from which two important facts are clearly established, viz.
the

the power of the nitrous acid to destroy contagion; and the safety with which it may be employed in any situation, without inconvenience or risk of fire.

It would be, perhaps, improper in me to detain your Lordship any longer on this subject, by endeavouring to point out the importance and extensive application of the present discovery; a discovery equally applicable to every species of putrid contagion, even to the plague itself; a discovery, therefore, in which all nations are more or less interested, but whose utility must be most sensibly felt by our own; where a commerce, extended to every quarter of the globe, covers the sea with our ships, whilst our gallant navy still maintains the decided empire of it.

*Oh fortunatos nimium, sua si bona norint,
Britannos!*

A RE-

A RETURN of those persons, amongst the attendants on the Hospital, or belonging to the Ship's Company of the Union, who were attacked with the Contagious Fever, from the 3d of September, 1795, when the Ruffian sick were first brought on board, to the 10th of February, 1796; the date of the last report.

(Signed) A. BASSAN, Surgeon of the Ship.

| Names | Quality | When seized | Recovered | Dead |
|----------------|-------------------------|-------------|-----------|---------|
| S. Brown | Nurse | Sept. 6 | _____ | |
| H. Warren | _____ | _____ 7 | _____ | |
| M. Mitchel | _____ | _____ 9 | _____ | |
| M. Reed | _____ | _____ 11 | _____ | |
| Mr J. Gardner* | S ^s 1st Mate | _____ 15 | _____ | Sep. 24 |
| M. Rawlins | Nurse | _____ 18 | _____ | |
| S. Hayes | _____ | _____ 20 | _____ | |
| Tho. Mitchel | Helper | _____ 22 | _____ | |

* He was discharged from the Union, and entered on board the Sandwich, the 12th of September; was taken ill a few days after, and died in about a week.

| Names | Quality | When seized | Recovered | Dead | |
|------------------------|-------------------------|-------------|-----------|--------------|---|
| A. Clavering | Nurse | Sept. 24 | | Sep. 28 | |
| Tho. Lee | Marine | — 29 | | Oct. 1 | |
| M. Sawyer | Washer-wo. | Oct. 6 | | — 15 | |
| Mr Meffersmidt | S ^s 1st Mate | — 6 | — | | |
| A. Bright | Nurse | — 8 | | — 11 | |
| D. Sawyer | Ab. | — 8 | — | | |
| H. Tuberville | Nurse | — 14 | — | | |
| Mr. Bodker | 2d S ^s Mate | — 22 | — | | |
| Cha. Walton | Ab. | — 22 | — | | |
| James Potter | Marine | — 22 | — | | |
| C. Taylor | Nurse | Nov. 2 | — | | |
| S. Parker | Washer-wo. | — 4 | — | | |
| Wm. Crasby | Marine | — 4 | — | | |
| Wm. Welch | — | — 10 | — | | |
| Rd. Welch | Ab. | — 10 | — | | |
| Henry Kelly | — | — 17 | — | | |
| Peter Parker | — | — 17 | — | | |
| Geo. Mantle | Marine | — 18 | — | | |
| Tho. Reed | S ^t Marines | — 18 | — | | |
| Jof. Copeland | Ab. | — 20 | | Dec. 4 | |
| Ja. Tuberville | Marine | — 20 | | Nov. 24 | |
| M. Clay | Washer-wo. | — 24 | | T. uncertain | |
| Before the Experiment. | | Total | 30 | 20 | 8 |

| Names | Quality | When feized | Recovered | Dead |
|--------------|---------|-------------|-------------------------|--------|
| Marg. Murray | Nurse | Dec. 25 | Recov. in a few days | |
| James Farmer | Marine | — 26 | | Jan. 6 |

Since the Experiment.—Total 2 1 1

N. B. On the 26th of November, the ship was fumigated for the first time, and the fumigation repeated twice a day till the 17th of December; from that time to the 26th of December, only once; but from the 26th of December to the 10th of February, twice a day, as at first.

A Weekly Return of the Ruffians received on Board his Majesty's Hospital Ship Union, in the Malignant Fever from the 3d of September, 1795, to the 28th of January, 1796, exclusive of those received in a state of debility after the said Fever, and with other diseases. By A. BASSAN, Surgeon of his Majesty Ship Union.

| Sept. 1795. | Received. | Discharged. | Dead. |
|-------------|-----------|-------------|-------|
| Sept. 3 | 37 | | |
| — 10 | 37 | 1 | |
| — 17 | 4 | 7 | |
| — 24 | 34 | 7 | 1 |
| Oct. 1 | 17 | 17 | 5 |
| — 8 | 29 | 15 | |
| — 15 | 20 | 5 | 2 |
| — 22 | 15 | 14 | 1 |
| — 29 | 18 | 11 | 1 |
| Nov. 5 | 31 | 9 | 1 |
| — 12 | 21 | 13 | |
| — 19 | 20 | 44 | 5 |
| — 26 | 29 | 39 | 1 |
| Dec. 3 | 12 | 5 | 1 |
| — 10 | 12 | 16 | 1 |
| — 17 | 35 | 48 | |
| — 24 | 8 | 25 | 1 |
| — 31 | 40 | 1 | |
| 1796. | | | |
| Jan. 7 | 52 | 25 | 3 |
| — 14 | 13 | 7 | 2 |
| — 21 | 20 | 24 | 3 |
| — 28 | 22 | 23 | 6 |
| Total | 479 | 356 | 34 |

N. B.

N. B. The greater part of the Russian Squadron sailed on a cruize November 29, and returned into port December 27, two or three ships at a time.

From the above return it appears, that the number of persons ill of the contagious fever, brought on board the Union, the two last months, December 1795 and January 1796, were nearly equal to the number received the two preceding months, October and November. It also appears that for the first month, after the ship was fumigated, there were few fever patients who died. The encrease in the number of deaths in the following month, may fairly be ascribed to the return of the fleet.

The first part of the paper
 is devoted to the general
 principles of the theory
 and to the derivation of
 the fundamental equations
 which govern the motion
 of the system. In the
 second part the particular
 case of a rigid body is
 considered and the
 equations of motion are
 derived in explicit form.
 The third part is devoted
 to the study of the
 stability of the motion
 and to the determination
 of the conditions under
 which the motion is
 stable or unstable.

A P P E N D I X.

Extract of a Letter from Mr. Keir, of Birmingham, to a Friend in Town.

January 25, 1796.

I consider Dr. Carmichael Smyth's discovery to be very valuable. The fumes in his process are quite different from the ordinary nitrous vapour in the distillation of aqua fortis, or from that which exhales in the solution of metals, by nitrous acid; the latter is highly suffocating and noxious, and may be called the phlogisticated nitrous acid vapour. The fumes made in Dr.

Smyth's manner (if there is no metal employed in the vessel, &c.) is highly dephlogisticated or oxygenated nitrous vapour, and is also mixed with a large quantity of pure dephlogisticated air, which is extricated from the materials, and these fumes are not only not suffocating, but have a very pleasant smell. If the distinction is not made between these two kinds of vapour, it is to be feared that some person, by accident, or in expectation of getting the nitrous vapour more expeditiously, may use metal vessels, or dissolve metals in nitrous acid.

*Extract of another Letter from Mr. Keir,
dated near Birmingham, March 3, 1796.*

The difference between the white nitrous acid, (called, by Dr. Priestley, dephlogisticated acid, and by the French chemists, acide nitrique;) and the red acid, called
phlo-

phlogisticated, or acide nitreux, is well known, and was first particularly noticed by Scheele, who shews how the one may be separated from the other by distillation. There is the same difference in the colour of the vapours from these two acids; and Dr. C. Smyth has himself observed, that the vapours, in the distillation of nitrous acid, were not noxious; which observation he has very happily and usefully applied. In distilling the nitrous acid from very small quantities of nitre, and oil of vitriol, in glass vessels, and when the materials are very pure, I have seen nothing but the white vapours, such as arise in Dr. C. Smyth's process, but Scheele says, that at the end of the operation, some red vapours rise, and it may be the case when a very strong heat is applied. But the very noxious red fumes which appear in the usual process of distilling aqua fortis, are occasioned, as you mention, by the iron vessels; and the manufacturers even put in old nails

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and small pieces of iron into their pots, in order to give a high degree of red smoking quality to the acid. When you acquainted me of Dr. C. Smyth's discovery, it occurred to me, that as the common notion of nitrous acid vapours, is confined to those that are red, some people might, in the first place, be prejudiced against it, from the idea of the vapours being noxious; as the red vapours are undoubtedly, and others might think that they made the process more effectual, by adding to Dr. C. Smyth's mixture, metals, or inflammable substances, in order to produce those red vapours. I therefore thought it would be proper for Dr. C. Smyth, to point out the difference between the vapours produced in his method, and the red nitrous fumes which are so well known; and also to caution the operators to avoid metal vessels, or the addition of metals or inflammable substances.

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There is a good deal of vital air extricated from the mixture, but I cannot agree with those who attribute the medicinal effect to it, we know little of this subject; but the analogy of the destruction of all animal and vegetable fermentation by mineral acids, which is well ascertained, inclines me to believe the agency of the acid, in the destruction of the contagion. The matter of which is, I presume, animal, in some vitious kind of fermentation.

A Letter from Mr. Bassan, Surgeon of his Majesty's Ship Union, to Dr. Carmichael Smyth, under date, the 16th of February, 1796.

DEAR SIR,

We had an encreased mortality amongst the Ruffians last month, but, thank God,
not

not from the contagious fever, that being now totally extinct; but from some being brought in a dying state, others in the scurvy, the most deplorable cases I ever saw, added to which, several hectic patients, who had been declining some time, happened to die at that particular period. I hope we shall have no return of so dreadful a calamity.

I remain,

Sir,

Your most obedient Servant, &c.

(Signed)

A. BASSAN.

Extract

*Extract of a Letter to Mr. Menzies, from
 Captain Chechagoff, Commanding Officer
 of the Russian Fleet, in the absence of his
 Excellency Admiral Hannicoff. Dated
 Chatham, March 9, 1796.*

Agreeably to your wish, it is with the utmost pleasure that I expose the proofs of a truth so useful for the human kind, and so much to the honor of those that are the primitive cause of it, and those that put them in execution, with an efficacy, as is acknowledged in the certificate here joined. I beg to present my compliments to Dr. Smyth, for whom I have the respect that is owing to all those who have assured their renommée *, by the good they have done to the public, and to get its suffrage. I am, with much esteem, &c.

(Signed) P. CHECHAGOFF.

* The public will recollect that Captain Chechagoff is a foreign officer, writing English, and therefore will not be surpris'd at his making use of one French expression.

CERTIFICATE.

“ It has been observed that the fumi-
 “ gation, with the nitrous acid, introduced
 “ by Mr. Menzies on board the ship
 “ Pamet Eustaphia, has produced, in a
 “ short time, the best effect in stopping
 “ the progress of the fever and other evils,
 “ which were then evidently increasing,
 “ for which reason it was not only regu-
 “ larly continued on board of that ship,
 “ even after Mr. Menzies’s departure, but
 “ adopted on board of others, and always
 “ found useful. It is therefore my duty
 “ to certify by this not only the good con-
 “ sequences that have been observed from
 “ that useful contrivance, but even the
 “ advantage that arises from its easy and
 “ sure execution, in comparison with other
 “ means of fumigating the ships which
 “ requires

“ requires greater attention from the fire
“ that must be made use of, and therefore
“ cannot be effectuated in all the parts of
“ of the ship.”

(Signed) CHECHAGOFF,

Captain and senior Officer of the
Russian Fleet.

March 10, 1796.

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requires greater attention from the
that must be made use of and therefore
cannot be effected in all the parts of
of the ship.

(Signed) CHICHAGOFF

Captain and Senior Officer of the
Russian Fleet

March 20, 1796

F I N I S