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AN
ACCOUNT
OF
TWO CASES OF DEATH
FROM EATING MUSSELS:
WITH
SOME GENERAL OBSERVATIONS
ON
FISH-POISON.

BY
GEORGE MAN BURROWS,
MEMBER OF THE ROYAL COLLEGE OF SURGEONS AND OF THE SOCIETY OF
APOTHECARIES IN LONDON ;
And One of the EDITORS of the LONDON MEDICAL REPOSITORY.

London :

1815.

2

ACCOUNT

TWO CASES OF DEATH

FROM EATING MUSSELS

SOME GENERAL OBSERVATIONS

FISH-POISON

BY GEORGE J. M. R. R. R.

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OF THE UNIVERSITY OF LONDON
AND OF THE SOCIETY OF MEDICAL PHYSICIANS
OF THE UNIVERSITY OF LONDON

LONDON:

1858.

NOTICE.

THIS PAPER was recently published in the *LONDON MEDICAL REPOSITORY*,—a work probably almost confined to the Profession. As the subject treated of is novel and interesting, has been much neglected, and is consequently little understood, a few copies have been separately printed for general distribution; with the hope of inciting others, more competent, to enter upon the Investigation of the Nature of FISH-POISON, than with any expectation of the WRITER that his Remarks have contributed to its elucidation.

*Bloomsbury Square,
July, 1815.*

ACCOUNT

of the

NOTICE

I have heard a very vague and unsatisfactory account of the death of two youths at Grimsby, in Kent, from eating mussels. I applied to Mr. Rogers, a Surgeon of that place, who I understood had attended them in their illness, for more accurate information of this melancholy event. He has this obliging communication, chiefly, I have collected the following

history. Mr. Rogers says: "I was called on Monday, July 4th, 1814, at 7 P. M. to visit Master Pearson, aged fourteen years. I found the countenance of an ashy paleness; the pupils extremely dilated; respiration difficult; incessant thrusts upwards; coldness of the extremities; the pulse quick, low, and tremulous, accompanied with sudorifics; in short, he appeared to be in critical morbus, and I informed his friends of his immediate danger."

"I learnt that his brother, aged nine years, had been at the same time afflicted with nearly similar symptoms, that death had ensued; but that he expired about three hours before I arrived. Concerning this alarming circumstance with the present state of my patient, I conceived that the brothers were victims of one and the same cause; and that they were poisoned by something they had eaten."

"I proceeded to evacuate the stomach and bowels, but the vital spark was too nearly extinct: he died in a few hours. The death of these two youths was so extraordinary, and the cause so perfectly obscure (for the family could in no manner suppose they had eaten improper food), that I pressed

AN
ACCOUNT,

&c. &c. &c.



HAVING heard a very vague and unsatisfactory account of the death of two youths at Gravesend, in Kent, from eating mussels, I applied to Mr. Rogers, a Surgeon of that place, who I understood had attended them in their illness, for more accurate information of this melancholy event. From his obliging communication, chiefly, I have collected the following history.

Mr. Rogers says: "I was called on Monday, July 4th, 1814, at 7 P. M. to visit Master Pearson, aged fourteen years. I found his countenance of an ashy paleness; the pupils extremely dilated; respiration difficult; insatiable thirst; nausea; tormina; coldness of the extremities; the pulse quick, low, and tremulous, accompanied with subsultus: in short, he appeared to be *in articulo mortis*; and I informed his friends of his immediate danger.

"I learnt that his brother, aged nine years, had been at the same time afflicted with nearly similar symptoms; that death had ensued; and that he expired about three hours before I arrived. Combining this alarming circumstance with the present state of my patient, I conceived that the brothers were victims of one and the same cause; and that they were poisoned by something they had eaten.

"I proceeded to evacuate the stomach and bowels; but the the vital spark was too nearly extinct: he died in a few hours.

"The death of these two youths was so extraordinary, and the cause so perfectly obscure (for the family could in no manner suppose they had eaten improper food), that I pressed

most forcibly for permission to open and examine the bodies. But the feelings of the unhappy mother, in the first ebullition of grief, opposed my wishes; and their bodies, soon after death, became livid, and too putrescent to put into execution my wishes, even if consent had been obtained.

“ Being denied this mode of satisfying my suspicions, I availed myself with the more care of the only resource; and was very minute in inquiries of the progress of this fatal attack, as a clue to direct me to the real cause of their death.

“ It appeared, that both children were unwell on Saturday afternoon, (July the 2d,) and were very sick. The youngest complained of head-ache, and also puked up a great quantity of blackish matter; as did the eldest the same evening.

“ On Sunday the 3d, they were still very sick, and frequently vomited a dark-green fluid; an eruption, like the nettlerash, covered the skin, and was attended with intolerable itching. Great difficulty of breathing, tormina, intense thirst, and swelling of the abdomen and face, followed; the extremities gradually became cold and quite benumbed. The youngest was delirious on Sunday; then comatose, with frequent convulsive contortions of the whole body, for some hours before his death; the elder was sensible to the last, and more tranquil. There had scarcely been any alvine dejection since the commencement of their illness.

“ The train of symptoms thus described may not be quite correct, or in the order of occurrence; but the account convinced me that some deleterious aliment had been taken. The similarity of symptoms to those I had seen before, arising from eating of shell-fish, induced me to take some trouble to ascertain whether these boys had been in any situation where they could have met with any of the various kinds easy to be procured in this place.

“ At length I discovered, that on Friday, about noon, the 1st of July, the two Master Pearsons, in company with other boys, had been playing in the basin of the canal. Therein laid a fishing smack for sale; her bottom very foul, with many mussels adhering. From the water in the basin having a few

days previously much subsided, the vessel had heeled ; that is, fallen on one side ; by which position the opposite side was raised beyond the reach of the water : consequently the mussels had been some time out of their element, and were dead and tainted. Of this, the boys, natives of the place, being aware, they did not eat of them ; but to the two Master Pearsons, who had recently with their family arrived from Oxfordshire, they were a novelty ; and being told that they were frequently eaten, each picked about a dozen of the smallest, which are *supposed* to be the spawn, from off the vessel, and ate them.

“ Of this they said nothing to their mother. She observed they ate little that day at dinner ; and that little was of gooseberry pudding ; they took besides a few shrimps in the course of the afternoon. But neither of them appeared ill, until the following day.

“ Nothing had been given with the view of relieving, till I visited the elder ; and this was just sixty-seven hours from the time of their unhappily eating these mussels ; to which I decidedly attribute this melancholy catastrophe.

“ The mother had no suspicion of the cause of their illness ; and from the gradual accession of the symptoms, she was less alarmed. She remembers that one of her sons asked, if she liked mussels : but from her ignorance of such fish, or of their alleged poisonous qualities, the inquiry did not excite her suspicions.

“ I have seen persons affected with the incipient symptoms exhibited by these children, from eating stale mackarel, and much more frequently from mussels ; but they were always quickly relieved by free vomiting and purging : and I never before knew nor had heard of any one dying from the effects of fish-poison of any kind.”

THE above interesting but distressing cases establish two points that have been much questioned ; viz. that shell-fish are in this country poisonous under certain circumstances ; and that the effect is sometimes mortal.

To some minds the danger of an evil is never imminent till it approaches, and threatens their own safety : but none, surely, perusing these cases, can be sceptical enough to deny, that there is a peculiar property or virus in fish which may occasionally prove highly dangerous.

So many naturalists and writers have concurred in the existence of fish-poison, that it might have been supposed no modern author would have ventured a contrary opinion. Yet a very judicious physician seems to doubt “ if there be such a thing as shell-fish poison ;” and is disposed to imagine*, the effects attributed to it depend on the state of the stomach of those who are affected by it, or on a peculiar idiosyncrasy of constitution. But, although it be probable that fish is more obnoxious to the stomach of one person than another, yet numerous facts controvert the opinion of such effects having always a constitutional origin : for a considerable number of persons have been similarly affected from eating of the same fish, though in different degrees of severity. The effect will of course vary according to the strength of the digestive organs, the quantity of the poison, and the mass and quality, perhaps, of other ingesta taken at the same meal.

There are, who, whenever they eat of particular kinds of food, are disordered, and uniformly exhibit the same symptoms. This I would pronounce idiosyncrasy of habit :—but when several are simultaneously affected by the same food, the cause must be with the food, and not the constitution. However, the authorities are so respectable and numerous, that the fact of a specific poison existing in fish is in disputable.

Of all that I have read of fish-poison, Dr. Chisholm's is the most elaborate dissertation†; and he has, with his usual industry, brought together, and cited a prodigious number of authorities, biblical and classical, foreign and domestic, to illustrate this curious subject ; and has displayed a great store of learning, in support of certain hypotheses. But, after all, I fear the

* Vide Dr. Stone on the *Diseases of the Stomach*, p. 80, 1809.

† Vide *Edinburgh Medical and Surgical Journal*, vol. iv. p. 392.

same obscurity prevails; and that his experience and his theories are of little avail.

Dr. Chisholm, not very philosophically, observes: "In vain would ingenuity be exerted in the investigation; fruitless would be the research for its solution:"—a maxim, that, if generally applied, would extinguish the pursuits of science; effectually check the progression of knowledge, and the improvement of the condition of mankind—the proper aim and object of all human studies. It is a position the more singular, because preferred by the learned Doctor; the whole tenor of whose life and actions have been the very converse. Indeed, the paper containing this remarkable passage bears testimony that it was unguardedly advanced.

It may perhaps seem presumptuous in any one, who has never possessed personal opportunities of observation, to offer even an opinion; and still more to attempt to elucidate a subject so abstruse, by the mere collation of such facts and remarks as are already disclosed, and bear upon the subject. Consequently it is with just deference that I engage in an inquiry so difficult, with such scanty materials: yet, however diffident, I am encouraged to hope that my remarks may be serviceable, were they only to attract a stronger degree of attention to it; and although they tend to no definite or practical result.

To a maritime nation, undertaking long voyages in unknown seas, fish must ever be an important article of food. However desirable, sailors nevertheless are frequently denied this enjoyment, from the knowledge of a poisonous quality existing in some, and the dread of it in other fish. That no complete investigation, therefore, of the nature of fish-poison has been entered upon, is a real reproach to science and humanity; and a just stigma on British polity: for although the operations of an extended warfare or the pursuits of commerce have carried our fleets round the world; and the preservation of the health of our navigators must consequently be an object of primary importance; yet, no naturalist, nor chemist, has been appointed by authority, or been moved by a love of research, to explore this mystery. In the instructions given to the scientific men

who accompanied Peyrouse, their notice was particularly pointed to it. But the fatality attending that celebrated voyager, prevented the completion of this, as well as of various other parts of his commission.

Their very element is an impediment to a correct knowledge of the natural history of fish. It is impossible to become acquainted with their *habitats*, or with the diseases to which, no doubt, they are subject; or with those remarkable physical changes of constitution that we know many undergo; and to which probably all are liable, as well as other animals.

But although there be obstacles to this inquiry being pursued, in the way and with the success that other departments of natural history are studied; yet by a judicious arrangement, and application of every observation resulting from experience; and by reasoning analogically, the occult property of fish-poison may possibly be ultimately discovered. Fully to accomplish so desirable an object, must depend on a series of experiments on the animals that contain and impart it, conducted in such situations as are known to be most favourable to its production.

Many fish, such as salmon, herrings, eels, mackarel, many of the testaceous and most of the crustaceous fish of this country, have occasioned symptoms similar to those from the poison of tropical fish; but in a degree so mild as never before to have proved fatal; or at least, if such have been the effect, it is so rare that the cases have escaped my observation.

The noxious effects of mussels (*Mytilus Edulis* of Linn.) have been frequently remarked by writers; and even to a degree to occasion death*. Capt. Vancouver relates, that several of his men were ill from eating some they collected, when exploring the coast of America, in the North Pacific Ocean. Three were more affected than the others; and one of them died†.

* Vide Behren's *Diss. de Affectionibus a comestis Mytilis*.

† The poison, in these cases, appears to have been particularly active. At 9 P. M. the party breakfasted on these mussels, roasted. In an hour they complained of numbness of the face and extremities, sickness, and gid-

The natural history of mussels was an object of interesting inquiry to *Reaumur*; but neither he nor the many learned physicians abroad*, who have noticed their poisonous qualities, have elucidated the cause of this peculiar property.

M. De Beunie, a physician at Antwerp, and *M. Du Rondeau*†, have written two very excellent papers on the subject; and the former has attempted to assign an origin to the poison; but his theory is too fanciful to bear the test of examination. He ascribes this quality in the mussel to the presence of a small sea-insect, a species of *stella marina*; because it sometimes lodges itself in the mussel; and because the spawn of that insect is so caustic, that when the skin is rubbed with it, an itching and swelling follows. But this, decidedly, is not the cause; for whether it be from the poison of mussels, or of other fish, the effects strikingly accord, differing only in the degree of severity.

If any systematic inquiry be ever instituted, it is not in this hemisphere the subjects of experiment must be sought: for although the effects described are occasionally met with in the temperate regions, yet, I conceive they are then generally accidental; arising either from that idiosyncrasy which makes the habit also obnoxious to various kinds of fruits, bitters, &c. as well as to some sorts of fish, or to some peculiar state of the fish, that is not innate, but adventitious.

It is chiefly within the tropics, where Nature is so redundant in her operations and productions; where every thing

diness. No relief being at hand, the officer commanding the boat party desired the crew, of which the invalids were a part, to row quick to promote perspiration, and thus dissipate the poison. In three hours they reached land; upon which, one immediately fell down. Some water was heated, and offered him; but he could not swallow it: and he expired in half an hour, perfectly tranquil, as if in a deep sleep. His lips had turned very black, and his extremities were much swollen. The other two men, by drinking plentifully of warm water, and exciting vomiting, escaped with their lives; but were ill for some days.—Vide *Vancouver's Voyage of Discovery*, vol. ii. p. 286, 287.

* Vide *Moehring de Mytilorum Veneno. agrot. 3. in Haller's Disput.* tom. iii. p. 191.—Dr. Wickmann of Hanover, and Professor Kock, have likewise published some excellent remarks on the effects of mussels.

† Vide *Memoires de l'Academie Imperiale et Royale des Sciences et Belles Lettres de Bruxelles*, tom. i. and ii.

that is useful or baneful, whether animal or vegetable, is in excess; and where all the poisons acquire an activity, as if from a higher degree of concentration; that the deleterious qualities of fish are found to be more general, and most virulent: yet it should be noticed, that fish extremely poisonous are found near Japan—a part far to the north of the tropic of Cancer.

The fish to be dreaded in the Caribbean Seas appear to be multifarious*: but, of all, the poison of the yellow-bill'd sprat

* It may prove useful to enumerate some of the poisonous fish, with their vulgar and systematic names; agreeably to such information as I have been able to collect. According to the Linnæan system, they may be thus arranged..

AMPHIBIA.

NANTES.

Old Wife.....BALISTES *monoceros*.
Smooth Bottle-Fish. OSTRACION *globellum*.
Tunny.....TETRODON *sceleratus* } of Forster.
Blower or Blazer.....TETRODON *ocellatus* }

PISCES.

APODES.

Conger Eel.....MURÆNÆ *major subolivacea*.

THORACICI.

Dolphin.....CORYPHÆNA *cæruleo varie splendens, cauda bifurca*.
Porgee.....SPARUS *Chrysops* and *S. Pagrus* of Forster.
Gray Snapper.....CORACINUS *fuscus major*.
Hyne.....CORACINUS *minor*.
Barracuda.....PERCA *major subargentea maculata, pinnis migrantibus* of Browne—*esox* BARRACUDA of Sloane—*BECUNE* of the French.
Rock Fish.....PERCA *venenata*, *P. Marina* of Browne.
Grooper.....PERCA *venenosa* of Catesby, or *trigla subfusca nebulata* of Browne.
King-Fish....SCOMBER *maximus, pinnulis utrinque novem, tuberculo rigido acuminato utrinque ad caudam*—TASSARD of the French—*Xiphias* of Browne.
Bonetta.....SCOMBER *thynnus*.
Cavalloe, Horse-eye } SCOMBER *macula nigra ad basin utriusque branchii*
and Green-backed. } *ostegæ et in utraque pinna pectorali*.

ABDOMINALES.

Spanish Mackarel....SCOMBER *cæruleo argenteus nudus* of Browne.
Blue Parrott Fish....MORMYRA of Browne.
Yellow-bill'd Sprat..CLUPEA *thryssa*, *Faunula Sinensis*.

INSECTA.

APTERA.

Sea Lobster.....CANCER *astacus* of Browne.
Land Crab.....CANCER *ruricolus*.
Mussel.....MYTILUS *edulis*.

(*Clupea thryssa*) is the most active and dangerous. Indeed, it has rarely occurred that immediate death has ensued between the tropics from the virus of any other fish; although the consequences of eating some have been so pernicious and durable, that they have yielded to nothing but a change to a colder climate.

Various are the conjectures on the nature of this poison; and whether it be confined to particular organs, or parts or the whole fish be infected. Some of these speculations are too loose to merit serious attention; yet they may be stated: others that are supported by respectable testimony or arguments, demand more consideration. Every thing, indeed, on the subject, at present, is but conjecture; and while the evidence rests on hypothesis, tradition, or the oral testimony of the prejudiced and ignorant only, the truth must be long before it is elicited.

All the opinions advanced, may be arranged under the following heads:

Does the poison of fish exist—1. *In the skin?*—2. *In the stomach and intestinal canal?*—3. *In the liver or gall-bladder?*—4. *In the entire substance of the fish?*—5. *In the food of fishes?*—6. *Is it a morbid change in the system of the fish?*—7. *Is it a poison, sui generis?*

1. *In the skin?*—The skin, it is well known, often partakes of the characteristic flavour of animals, and is usually more difficult of digestion than other parts. Hence it frequently disagrees, when the muscular or fat parts sit perfectly easy on the stomach; and hence, solely, when ill effects have succeeded the eating of fish, it has been attributed to the skin. It most likely participates in the other qualities of fish; but I deny that the poison ever resides in that membrane alone: there are no facts to support such a position*.

* Two cases of *Urticaria* were reported, last December, to have been consequent on eating the *skin* of red herrings.—Vide *Medical Repository*, vol. iii. p. 83. But upon making further inquiries, I learnt that a tradesman's wife and the apprentice had been taken suddenly exceedingly ill, after having eaten, not of the *skin* only, as reported, but of the *whole* of the fish.

There are two circumstances worthy of noting in this incident: 1. That

2. *In the stomach and intestinal canal?*—Experience has proved that the poison of fish is particularly active in those parts which are commonly called the offals; in which term are included the stomach, intestines, gall-bladder, &c. Numerous instances are recorded of dogs, cats, hogs, and birds, dying or being made extremely ill from eating those parts. It is said, also, that such have been the effects on brute animals; while persons, who have partaken of the fish, to which the offals belonged, remained uninjured. Dr. Thomas*, and others, relate, that even the yellow-bill'd sprat is eaten with impunity, if it be first carefully gutted. But this admits of doubt; for I fear all these accounts are derived from oral testimony, and are, therefore, too vague to be depended on. We must also receive with caution all conclusions drawn from comparative effects of any substances on man and on animals:—an error into which many physiologists run, in deductions from their experiments. Perhaps there are no two animals upon whom the same substances would act similarly. It is very possible, that the same quantity of fish-poison that kills brutes, would merely disorder, or even not affect man: for it is fully proved, that it is always much more dangerous to the one than to the other.

From the effects of the offals of venomous fish upon animals, it has, I apprehend, been inferred, that the poison was in the stomach and intestines; and, therefore, has originated with their food; and this impression is so general, that it deserves particular notice. But the discussion of this part of the subject is so interwoven with some peculiar theories, that it must be reserved, hereafter to be examined.

3. *In the liver or gall-bladder?*—The seat of the poison has been said to be exclusively in one or both of these viscera.

as two persons, not related, ate of the red-herring, its effects were not imputable to any family idiosyncrasy of constitution; but to an action of a specific nature. 2. That the process in curing herrings is not an antidote to the poison, when it exists in the system of the fish.

* Vide *Memoirs of the London Medical Society*, vol. v.

But this assertion rests entirely on supposition. It is not probable that either of these viscera should secrete a specific virus, without contaminating the animal of which it forms an integral part. I do not mean to advance, that a specific poison may not be generated by some natural process, and confined to a distinct part of an animal. The venom of serpents is secreted and separated from the other fluids, and lodged at the base of their fangs; bees and venomous insects secrete, and eject through the sting, a poisonous fluid, from a particular reservoir; and in many animals, for various purposes, secretions peculiar to each are formed, and deposited in different parts of their bodies: but in these cases, the substance of the animal does not partake of such quality. And the functions of the liver are too prominent and important in the animal economy, to conceive, that, in a healthy state, it performs any offices, or secretes any matter in one fish dissimilar to another. Indeed there are direct facts to disprove that the poison is confined to the liver or gall-bladder.

Captain Cook, and the Messrs. Forsters, were poisoned by eating a piece of the liver only of a species of *tetrodon*, which was attended with some singular symptoms: yet they who ate of its flesh were likewise poisoned*. *Sauvages* has remarked on the poisonous qualities of the liver of fish; but he does not say that the substance of the fish to which such liver belonged was not also noxious.

Mr. Quarrier, aware of the alleged poisonous properties of the gall-bladder, ordered it to be carefully removed from an albicore immediately it was caught; but nevertheless the fish proved highly deleterious†. In short, I can find no authority to suppose that the liver or gall-bladder alone contains any poisonous quality; but believe that when one part of a fish is poisonous, the whole is equally pernicious.

4. *In the entire substance of fish?*—That a poisonous quality frequently pervades the substance of fish, is indisputable; and

* Vide *Philosophical Transactions*, vol. lxvi. p. 544.

† Vide *Medical and Physical Journal*, vol. xxv. p. 398.

it would be a work of supererogation to enumerate all the instances on record. The sceptic may consult Dr. Chisholm's Dissertation, before referred to, who has certainly taken great pains to collect authorities; and also some few others that I have quoted. The personal experience, or observation, of those who have been in the West Indies, will likewise furnish abundant testimony of the fact.

5. *In the food of fishes?*—Because the poison of fish has been found peculiarly active in their first passages, it is strongly insisted on that it must proceed from their food. But this idea is entirely conjectural. Yet as most writers who have noticed the subject, and common opinion, concur in attributing it to this cause, it therefore demands a more ample investigation: and, as I cannot accord with such inference, it is incumbent on me to discuss the question at large, and candidly to state the grounds of my rejecting it.

The first and most essential step to a correct knowledge of any subject, is, to dispel vulgar and erroneous prejudices, by opposing to them positive facts, and inductions palpable and capable of proof; and until false impressions are weakened or dispersed, it is in vain to attempt to substitute truth for error. Hence it will be impossible to avoid prolixity in this section.

The most prevalent opinion is, that the poison of mussels is of a *mineral origin*, from their feeding where *copperas* is found. The same source has been ascribed for the deleterious qualities of various fish found in the West-Indian seas*. Others assert that it is *cupreous*; which seems most favoured by Dr. Chisholm; some, that it arises from fish feeding on the *galere* or *gally-fish* (*medusæ* and *holothuriæ*); others again, from the *manchenelle apple*; and Dr. James Clark, of Dominica, conceives that it is from their food consisting of *submarine narcotic plants*†, such as the *corallina opuntia*.

Of all these various hypotheses, the arguments adduced in support of its being of mineral origin have the greatest plausibi-

* Vide Dr. Thomas on Fish-Poison, *Mem. Med. Soc. of London*, vol. v.

† Vide *Medical Facts and Observations*, vol. vii. p. 294.

lity ; and, consequently, require the most serious examination. The evidences for the rest are so improbable, imaginary, or contradictory, that I shall only cursorily treat of them.

The idea that the deleterious quality is derived from copperas, is founded in ignorance of the history and nature of that substance ; and perhaps from certain fish, as *oysters*, &c. frequently being of a greenish hue*.

The name, *Copperas*, carries with it the impression that this substance is derived from copper. But copperas, the green vitriol of commerce, is not an educt of that metal ; but is a sulphate of iron—a salt that is not an active poison ; and seldom injurious, except when improperly administered as a medicine, or in too large quantities. The error, too, has probably been strengthened from the similarity in colour of copperas and verdigris ; which last salt, as commonly met with, is a subacetate of copper.

Among the many accounts that fish-poison has a mineral origin, I have not met with a single proof, nor one good reason that is worthy of respect advanced, except Dr. Chisholm's, of copper being its basis. But as Dr. C. admits that he has little or no confidence in the results of his own inquiries or observations, they are fully open to animadversion : and as he is manifestly wrong, even in some of the principles he has assumed, to examine them is essential to the forming of more correct data.

I. In what manner is copper accessible to fish ?

* The colouring of oysters, green, is sometimes undoubtedly a natural operation. But it is also adopted, by artifice, from epicurean motives. The Dutch formerly took oysters from beds on our coasts, and deposited them on their own, where from experience they knew they would soon acquire that greenish tint that renders them more desirable to the luxurious. Native oysters, transposed into the Colchester beds, soon assume this appearance ; and are hence more esteemed. In these situations there is always a large quantity of green deposit from the sea, probably the vegetating germs of marine *confervæ* and *fuci* ; and which impart their colour to the oysters. The facility of dying even the bones of living animals, by the absorption of coloured vegetable infusions, is well known to physiologists. Hence the green colour perceivable in an oyster, which is almost diaphanous when out of the shell, is easy of solution. The bones of the Gar-fish or sea-needle (*Esox belone*) turn green by boiling ; yet this fish has never really proved unwholesome, though often suspected.

II. Is copper, if accessible to, and becoming a part of their food, inimical to fish?

III. Are the symptoms, characteristic of the operation of fish-poison, ever produced by animals or substances, of which copper is not known or suspected to be a component part?

I. Dr. Chisholm conceives that copper may be held in solution by the water of the tropical seas; and thus become a part of the food of fish.

Granting that he is correct in his geological description of Antigua, the contiguous islands, and of the straits that insulate them; and that copper abounds among them—is that a feasible reason for supposing that copper is actually held in solution in the water of those seas?

Sea-water, in a great variety of places and latitudes, has been chemically examined, for the purpose of ascertaining its constituents; and although these may sometimes have varied in their proportions, yet no trace of copper or any other metal has, I believe, ever been detected. Modern research has nowhere discovered, that the sea that laves the shore of a country abounding in mineral productions partakes of the qualities of such minerals.

To support his theory, that copper may be held in solution in the sea-water, round the islands of Antigua, &c. Dr. Chisholm says, that “if heat is a necessary condition in the solution of copper by the muriatic acid, (the basis, he observes, of sea-water,) we can the more readily perceive the cause of the natural solution of this metal in the West-Indian or tropical seas;” and concludes, that the temperature of the sea-water is there much greater than in cold or temperate climates: arising—1. from the innumerable submarine volcanoes and pyritous beds;—2. from the insupportable heat of the sand in many places;—3. *from the proportion of the oxygen in the atmosphere of the torrid zone being so much greater than in other regions*;—and hence there is a probability “of the oxygenation of the muriatic acid being a frequent natural chemical combination*.”

* Vide *Edin. Med. and Surg. Journal*, vol. iv. p. 401.

Now it has been proved by experiments, particularly those of Humboldt and Bonpland*, that although the temperature of the surface of the sea in the torrid zone be nearly equal to the surrounding atmosphere; yet, that at a greater depth the temperature is much lower, varying with the shallows and with the currents flowing from different climates. The same results followed at Teneriffe, although in the vicinity of volcanoes; and also at Cumana, which in latitude and longitude differs but little from the Caribbean Isles; and where, even on the sea, it might be said, from very recent and melancholy experience, that they were over subterranean fires. The difference of temperature of the sea, in high or low latitudes, is not so great as might, from the variance of heat of climates, be supposed†: for it has been invariably found, that where “the temperature of the atmosphere is warmer than the surface of the sea, the superficial water was hotter than at a great depth; and when the atmosphere was colder than the surface of the sea, the superficial water was colder than that which was deeper.” By which wise law of Nature, a beneficent provision is made against an excess of heat or cold in the habitable world. Hence I conclude, such a high degree of temperature as Dr. Chisholm finds prevenient for a solution of copper in seawater, to be utterly impossible‡.

If there be any dependence on chemistry, it has been ascertained, by the most accurate experiments, that the quantity of oxygen in the atmosphere of every climate and place is precisely

* Vide *Political Essay on New Spain*, vol. iv. p. 149.; and *Personal Narrative of Travels to the Equinoctial Regions*, &c. vol. ii. p. 50.

† The German Sea is but little more than three degrees colder than the Atlantic in winter; while it is five degrees warmer in summer. The Mediterranean Sea is warmer, both summer and winter, than the Atlantic.—Vide *Kirwan's Temperature of Latitude*, p. 53.

‡ Eller has proved, by experiment, that if water, containing one twentieth of muriate of soda (common salt), be boiled in a copper vessel, and the liquor be evaporated, an oxide of copper may be obtained: but the heat must be carried to the boiling point to produce this result. Happily, however, he found also, that if meat, fish, or lard be boiled in this same solution of salt and water, no cupreous particles were detected.—Vide *London Medical Repository*, vol. ii. p. 495.

the same. Therefore, the theories of the solution of copper in sea-water, and the hyperoxigenation of copper in the torrid, more readily than in the temperate zones, must be fallacious.

II. The superficies of the island of Antigua in the Caribbean Seas, and of Anglesea in St. George's Channel, almost exactly correspond. Dr. C. says, he saw considerable traces of copper in the former: the latter is known to produce immense quantities of this metal; and the smelting houses where the ore is separated, being on the sea-shore, the surrounding water may be suspected, in some degree, to be impregnated: yet the fish that frequent it are not remarkable for any poisonous qualities.

Since copper has been so much used for sheathing the bottoms of ships, the fishermen of the Thames and the Medway have observed that some sorts of fish, particularly salmon, have deserted those rivers; and others are to be found only in those parts where such vessels have little or no access: evincing that the copper is obnoxious to their taste and increase. Besides, is it not notorious, that if the bottoms of ships, returned from a long voyage, be examined, few or no shell-fish, comparatively, are found adhering to those which are copper-bottomed, while those not coppered are loaded with them?

A frigate was stranded on one of the Virgin Islands; and to her copper bottom some oysters were found adhering: of these the crew ate, and they were ill: whence Dr. C. imagines they were impregnated with that metal. But does it follow, if shell-fish attach themselves to the bottom of a vessel, that they derive their nutriment from it, any more than when attached to a rock—their more natural and common refuge? The real cause of these oysters proving unwholesome will be hereafter suggested. Hence it is probable, that, if not actually inimical, copper is obnoxious to fish.

III. Although the symptoms of fish-poison vary in different persons, resulting from different circumstances, constitutional or accidental, yet they certainly preserve a remarkable uniformity in all; as if produced by one and the same cause. But the same effects have been occasioned by fish caught in the main ocean, as well as by those taken in shallow waters, nearer

the land ;—a situation where no cupreous impregnation, from food, could be reasonably supposed to occur.

The symptoms, from eating of land-crabs, many drupaceous fruits*, as peaches, cherries, almonds†, &c., are strikingly analogous to those from fish-poison. These substances have exercised their noxious properties simultaneously upon several persons, partaking of them; which could not, therefore, be imputed to predisposition or idiosyncrasy, as might be suspected when one only of a party is affected.

There being both animal and vegetable substances known in which no copper can be suspected to be latent, yet exciting effects on the human body resembling those from fish-poison; and no fact to prove the existence of copper in the food of fish; I feel justified in concluding that the basis of fish-poison is not cupreous. Although I think it not impossible that it may be hereafter discovered, that whatever be the principle, it will be found in its nature to be in all substances synchronous.

There is mention made by Dr. Chisholm of a fact, that would, reasoning *à fortiori* from its coincidence with the results of very recent experiments, go much farther to support the theory of fish-poison having a cupreous basis, than any argument I have yet read.

M. Orfila, in his admirable work (*Traité des Poisons tirés des trois règnes; ou Toxicologie générale*), affirms, that sugar is a most decided and certain counter-poison to copper; and, upon the authority of M. Marcelin Duval, who first pro-

* Dr. Winterbottom says, that four persons were affected with *Urticaria*, and the other attendant symptoms, from eating a fruit like a damson, in the woods of Sierra Leone. He also mentions that these peculiar symptoms sometimes are excited by compounds, such as salmon with milk; when, either taken singly, is harmless.—Vide *Med. Facts and Observations*, vol. v. p. 57, 59, 60.

† M. Levillain, and his companions, were seized with severe vomitings, cramps, vertigo, &c. from eating a species of almond, the size of a walnut, which they gathered in the woods *à la Terre d'Edels*.—Vide *Voyage de Découvertes aux Terres Australes*, par M. Peron, tom. i. p. 185.

posed its exhibition, asserts that either in substance or solution, as an antidote, it has never failed of success*.

Now Dr. C. informs us† that his friend Mr. W. Stevenson, late of St. Kitt's, always administered the fresh juice of the sugar-cane as an antidote to fish-poison in the West Indies, with the happiest effects; and that when this could not be procured by the common people, they drank the expressed juice of the sweet potatoe (*convolvulus battatas*) with the same success.

It is also evident, that there is a very striking resemblance of the symptoms from copper and those from fish-poison on the human frame.

M. Orfila has given a summary of the symptoms attendant on the operation of cupreous poison‡: they have been also accurately described by many other writers, with whose description his corresponds; and it is impossible not to admit the affinity of the effects of fish-poison and copper. But yet there is, in all the histories I have read of poison from copper, the absence of the characteristic diagnostic of poison from fish—the violent cutaneous irritation and peculiar eruption, or nettle-rash,—a symptom, which, although attending poisoning by many other substances§, is not an effect of copper, yet it appears uniformly from fish-poison. This circumstance sufficiently

* Vide *London Medical Repository*, vol. ii. p. 499.

† Vide *Edinburgh Journal*, vol. v. p. 415.

‡ “The taste, acrid, styptic, coppery; the tongue, dry and parched; a sense of strangulation in the throat; coppery eructations; continual spitting; nausea; severe vomiting; or fruitless efforts to vomit, a sensation of pulling of the stomach, which is often very painful; dreadful colic; very frequent, sometimes bloody and black, stools; with tenesmus; debility; the abdomen inflated and painful; the pulse small, irregular, hard, and quick; syncope; the heat natural, and thirst ardent; respiration difficult; præcordial anxiety; cold sweats; scanty urine; violent cephalalgia; vertigo; prostration of strength in the joints; cramps; convulsions; and death.”—Vide *Traité des Poisons*, &c. p. 273.

§ The rash, mentioned by Dr. Percival, attending on the young lady poisoned by the eating of pickles impregnated with copper, was that only which is often observed arising from acrid and indigestible substances taken into the stomach.—Vide *Percival's Works*, vol. iv. p. 221.

marks a difference in the nature of the poisons ; and proves, in my opinion, that they have not the same origin. Nor can I admit their identity, because sugar is an antidote to both poisons. Were we to adopt such an inference, we ought to class diseases according to the remedies of the *Materia Medica*, rather than by their characteristic symptoms. Nevertheless, if sugar be an antidote to both poisons, it affords just ground for hypothesis, the correctness of which ought to be tested by the ordeal of well-conducted experiments*.

Next to the opinion of a metallic origin, ranks that which supposes the poisonous qualities of fish to be derived from their feeding on gally-fish (*medusæ* and *holothuriæ*). But, ere we attach credit to this report, it should be first proved that these inhabitants of the deep are in themselves poisonous.

Mr. J. R. Forster conceives the poisonous property of fish arises from their feeding on *molluscæ*† : but, forgetting that he has delivered such an opinion, in another part of his work he says, *molluscæ* are articles of food for the inhabitants of the islands of the Pacific Ocean ! It is not improbable that the noxious qualities of the *medusæ* may have been inferred from the well-known phosphorescent and electric properties some of the species (*medusa noctiluca* and *M. pelagica*) possess‡. Possibly *M. Bomare* may have been influenced in his imputation of their venomous qualities from the same causes ; as he says : “ que s’il touche la chair de quelque autre animal, il y cause une chaleur extraordinaire, &c.” These molluscæ are actually innocuous in the European Seas : therefore, if ever they are poisonous as food between the tropics, it is most likely from

* Dr. Chisholm relates, on the same authority, that the juice of the sugar-cane was administered to a dog apparently in the agonies of death from eating of arsenic that had been mixed for killing of rats ; and that his recovery was almost immediate. M. Orfila, too, advises the taking of large quantities of sugar, honey and water, &c. to obviate the effects of poisoning from arsenic.

† Vide *Observations on a Voyage round the World*, p. 648.

‡ Mr. Forbes, in his *Oriental Memoirs*, mentions some poisonous *medusæ* in one of his voyages ; but in a manner not likely to inspire any confidence in the account.

the same occult cause that affects so generally various fish of those latitudes.

That this deleterious principle should exist in so great a variety of fish inhabiting so vast an extent of sea, is positive proof that it cannot be the consequence of the manchenelle apple—a product of the land only: and that it proceeds from feeding on sub-marine narcotic plants, there is not the slightest testimony. I shall therefore dismiss these opinions, as requiring no formal refutation.

It is not a little singular, and it is certainly unfortunate as far as regards evidence of food being the cause of the poisonous qualities of fish, that so few of those who have felt or witnessed the effects, have examined the contents of the stomachs of fish which have proved deleterious—the only true test, surely, of this disputed point. Mr. Forster intended so to do; but, unfortunately, let every opportunity slip: Mr. Quarrier is the only person who speaks positively from personal inspection as to the fact. He states*, that in the stomach of the albicore, which proved poisonous, nothing was found but the small-fish it had devoured.

Such are the grounds to support the hypothesis, that the poisonous properties of fish depend on the substances on which they feed†. Upon a dispassionate review of them, we may fairly reject all inductions from such premises.

6. *Is it a morbid change in the system of the fish?*—The physical changes to which, I presume, all kinds of fish are subject, occur, no doubt, at regular and marked periods. Some of the fish of northern latitudes, however, sustain little or no perceptible change; are always edible; and rarely, if ever, deleterious. But the fish, noticed as producing the anomalous and deleterious effects that are some-

* Vide *Medical and Physical Journal*, vol. xxv. p. 398.

† I do not mean to assert, that the flesh of an animal cannot be imbued with a deleterious quality from that of its food. Dr. Barton says, that the common pheasants proved fatal to many persons, in America, from the birds having eaten of the leaves and buds of the *kalmia latifolia*. Vide *American Phil. Trans.* vol. v. No. 7.

times observed in Europe, are those that contain an oily quality, and are luscious and high flavoured. These, such as salmon, herrings, pilchards, sprats, &c. Cullen remarks, though less easily digested, and more irritating to the system, are the most nutritious*: they may be denominated *oleaginous*—that is, when in a state of perfection, possessing an excess of oil. This oil has an aroma peculiar to, and distinctive of each kind of fish; and upon which the flavour depends. If such fish be caught out of season, they are deficient of this oil; and the smell, taste, and colour, are different or defective. These remarks, also, apply to several shell-fish; and these, though not known to possess the same quantity of oil as some fish, have a portion of it, and a characteristic odour, viscosity, and richness, that they also lose at certain periods. The *crustacea*, also, which annually cast their shells, undergo changes that are truly wonderful. The fish of this hemisphere, during such changes, are unquestionably less nourishing, and, perhaps, may be unwholesome; but are never, on this account, virulently poisonous.

The black land-crab (*cancer terrestris*, or *ruricolus*), which, at certain seasons, is deemed in the West Indies a great delicacy, at others, occasions the same symptoms as those arising from fish-poison. This, too, is imputed to the quality of its food: because, during its abode in the mountains, it feeds on the leaves and produce of the mountain mahault, or manchenelle. And as a proof that this deleterious quality is derived from these poisonous vegetables, it is stated, that if the crabs are put into coops, purged with the leaves of the physic nut (*jatropha curcas*), and fed on wholesome vegetables, they became perfectly innocuous. They migrate, periodically, in March; and are regulated by the same law, call it either reason or instinct, that prompts many kinds of animals to congregate, and migrate, for change of climate, food, or the purposes of procreation. If animals, during the migrating season, be exa-

* Vide *Materia Medica*—of *Aliments*.

mined, great alterations in their economy are perceptible; which often destroys numbers of them; and they are then unwholesome, if not pernicious. Thus it is that cause and effect are often confounded. May not this land-crab, during the time it frequents the mountains, be dangerous, owing to a depraved or vitiated condition of its secretions only? for, when placed in a more genial situation, nutritious diet in a little time improves its health, and renders it wholesome*.

In alluding to the cause of poison in mussels, Dr. Rony rejects the popular notion, that it proceeds from little crabs lodging within the mussels; as he likewise does *Moehring's* opinion (*Eph. d'Allem. an.* 1774), that it arises from two diseases to which the fish is subject; one from moss (*confervæ*) insinuating its roots into the shells, and thus exposing the fish to be gradually dissolved by the constant admission of water; and the other, from a kind of tubercle observed on the fish, supposed to arise from the dissolution of the shell. He refers, in fact, for the cause, to a morbid condition of the fish†.

Dr. Chisholm and other writers affirm, that the safe or dangerous state of the larger and more rapacious fish, as the barracuda, &c. is to be detected; for that there are certain marks observable, indicative of the morbid state; during which they are poisonous. These signs are: the teeth dark-coloured, the gums swelled and bloody, and the chaps corroded and bloody: they are then particularly languid, and emit a peculiar smell. It has been surmized that this morbid appearance proceeds from the fish themselves being poisoned by the food they have eaten; and that it is during the action only of this food that the

* It is remarkable that the bag or stomach of this creature changes its juices with the state of the body; and while poor is full of a black, bitter, disagreeable fluid, which diminishes as it fattens; and at length the flesh acquires a delicate, rich flavour.—Vide *Brown's History of Jamaica*, p. 423.

A certain kind of lobster, in much esteem in Japan, is observed, if eaten when a part of it is of a black hue, to occasion "the belly-ache and cholera morbus."—Vide *Kæmpfer's History of Japan*, p. 138.

† *Gazette de Santé*, March 21, 1815.

fish is injurious to those who partake of it*. But have we any reason to imagine that fish are not endowed with the same instinctive faculty as other animals, in choosing their food? Is it not more rational, to ascribe these morbid changes, especially as they are observed to be periodical, to a natural rather than to an artificial or accidental cause†?

Experience proves, that the yellow-bill'd sprat, the most

* Many vulgar and absurd prejudices exist against the unwholesomeness of various animals, because some feed on substances known to be prejudicial to man, or because they are so to other animals. But have we not abundant proofs that many vegetables, that are virulent poisons to some, are to others objects eagerly sought, and devoured; and on which they fatten?

*Tantaque in his rebus distantia, differitasque est,
Ut quod aliis cibus est, aliis fuit acre venenum.*

Lucret. de Rerum Natura, lib. iv.

Substances may be assimilated by the digestive organs, without imparting their pernicious property to the flesh of the animal.

† Our knowledge of Natural History is yet by far too circumscribed, to enable us to draw decisive conclusions. Domesticated animals become the creatures of necessity, by which their actions are guided, volition being almost denied. Neither, perhaps, is it possible that human conception can ever comprehend the laws by which an Omnipotent Power regulates the operations of its own creation. That all animals possessing life, seek and obtain some kind of food for their support, is certain. But do we know what they require, or what is their capability of abstinence? Herrings, at certain seasons, frequent particular parts of the seas in such immense shoals, as to extend many miles; and of a proportionable depth. They are then in the highest condition; but if their stomachs and intestines be at that time examined, not a trace of food is to be detected. It is when they are out of season, when evidently in a morbid state only, that food is to be found in their stomachs. (Vide Dr. Anderson's *Researches in Agriculture, Natural History, &c.* vol. ii.) Judging from the multitude, we might suppose that no particular spot could furnish food for the flight of aquatic birds, Capt. Flinders saw, near Van Dieman's Land (Vide *Voyage to Terra Australis*), which, by computation, must have amounted "to one hundred and fifty-one millions five hundred thousand birds;" and to lodge them, would require an extent of space eighteen and a half square geographic miles! The same shoal of fishes (*bonnettus*) followed Peyrouse's ships fifteen hundred leagues; and left them only when they entered among the Sandwich Islands (Vide *Peyrouse's Voyage*, trans. p. 353.)—a convincing proof of their vigour, and pertinacious instinct in pursuit of their favourite and probably natural food.

How inane and futile, therefore, must all reasoning be, founded on speculations of properties imbibed or imparted by animals from the nature or quantity of their food!

poisonous of all the fish of the Caribbean Seas, is highly dangerous immediately after it returns from depositing its spawn; and much less (many say it is entirely) innocuous at other seasons—a fact strongly corroborative of the poison depending on some morbid condition.

But there are many who have noticed the phenomena of fish-poison, and have regarded them uniformly as the result and effect of a state of putrescency. It is clear, that the mussels which the Master Pearsons ate, and that proved so fatal, were dead, from the sudden subsidence of the water in the basin of the canal two or three days previously to their being removed, and which before had covered the bottom of the vessel to which they were adherent; they were also tainted—that is, in an incipient state of putrefaction. There is no question that the oysters taken from the bottom of the frigate (see page 16) were in the same condition*.

Another fact that strengthens the opinion that the poisonous properties of mussels depend on a state of putrescency is, that Mr. Barrie, the officer who accompanied Captain Vancouver's men, relates, that those which produced such fatal effects were collected on the shore; but it was observed, that the same sort of mussels gathered from the rocks were innocuous†. Many of the former were probably thrown up, and left by the sea, and were stale and tainted; the latter must have been covered by every tide, and were consequently fresh and sweet.

* It is generally understood that oysters, like mussels, do not possess the power of locomotion. *Reaumur* proved by experiments, that when mussels had once fastened themselves to the sides of the vessels in which they were placed, they remained immovable, even when the water was withdrawn, which was the source of their existence. Hence it appears more probable, that the mussels eaten by the young Pearsons must have been dead. The immobility of this species of shell-fish, when once fixed, is confirmed by all fishermen, who remark also that the propagation of them on ships' bottoms is exceedingly rapid. The bottoms of the frigate and the fishing-smack were both exposed to the rays of a burning sun; and the fish on them to so great a degree of heat, that they soon became tainted: yet the oysters from a vessel copper-bottomed, and the mussels from one with her bottom pitched, produced the same symptoms.

† *Vancouver's Voyage*, vol. ii. p. 286.

It is far from my intention to attempt to examine whether a state of putrefaction can be co-existent with vitality, or whether the vital power be always extinct before that process commences. But I think it must be allowed that when the secretions are vitiated and altered, and the functions of the animal impaired by diseased action, there is existing a condition of parts more favourable to putrefaction; and that there really is then a predisposition to undergo decomposition with great rapidity; and further, that such decomposition may be accelerated or retarded by the degree of temperature to which the body is exposed.

It is confidently asserted that the fish between the tropics are more dangerous at certain seasons than at others. Indeed on this point all reports so completely coincide, that it demands our credence till disproved. *M. de Beunie* and others have observed the same of mussels in the German Ocean. And it is important to note, that the period when it appears that fish are most poisonous, is, during the months when the influence of the sun is greatest, and consequently the temperature highest. I consider this circumstance so important and relevant to the question, that I shall place in chronological order the instances recorded of poisoning from fish which I have met with, and the dates when they occurred.

Quieros relates, that in latitude 14° South some excellent fish were caught; but that "it happened, that amongst some *pargos* (Forster supposes these to be the *sparus pagrus*) bringing some that had eaten *poisonous plants*, all parts of the flesh became empoisoned," and the crews of his ships were disabled by eating them. He says, also, "the ships appeared like the hospitals of a city which had the plague; there was none who could stand on their feet." These fish were caught about the 1st of *June* 1606. *The fish eaten the day they were caught produced no bad effects; but on the following day they were a virulent poison**.

Captain Cook and the Messrs. Forster were poisoned by

* Vide *Dalrymple's Coll. of Voyages*, p. 140, 141.
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the *sparus pagrus* (Linn.), and the crew soon after by a species of *tetrodon* (*sceleratus*) caught off New Caledonia. This was in *July*. Mr. Forster remarks, that these fish were dressed the day after they were taken; and those that were salted, and not eaten till four days after they were caught, were most deleterious*. The natives were well acquainted with the evil properties of this fish, and always refused it.

Mr. Quarrier, Surgeon of His Majesty's ship *Princess Charlotte*, mentions† that, in lat. 00° 16' south, long. 4° 57' west, they caught an albicore weighing 176 lbs. It was immediately and carefully cleansed of the offal, cut into junks, and hung up; a part was eaten the same day without any ill effects; but on the following day a young midshipman of a plethoric habit was alarmingly ill from eating of the same parts that were before innocuous; and several other officers were affected, though in a slighter degree. The mode of cooking made no difference in the effects. *This fish was taken on the 15th of September.*

Mr. Q. further remarks, as a singular fact, that, if the mackarel caught at St. Helena be kept a night, they are invariably poisonous; but if dressed the same day they are taken, they are excellent and harmless.

The mussels that killed Captain Vancouver's man, and poisoned others of his crew‡, were eaten on the 15th of *June*; those that destroyed the young Pearsons in *July*.

From the information collected by Dr. Thomas, Dr. James Clarke, and Dr. Chisholm, in the West Indies, the months of *May*, *June*, and *July*, after the fish have spawned, are considered the most dangerous.

M. de Beunie states that mussels are deleterious in *May*, *June*, and *July* only. But *M. du Rondeau* says§ they are poi-

* Vide *Forster's Observations on a Voyage round the World*, p. 643.

† Vide *Medical and Physical Journal*, vol. xxv. p. 398.

‡ It should be remarked, that though this place be situated on the Continent of America in the North Pacific Ocean, yet it is in latitude 52° 48', which is parallel with that of England, and the time being Midsummer, these mussels were possibly exposed to a temperature very similar to those that proved so fatal at Gravesend.¶

§ *Memoires de l'Acad. de Bruxelles*, tom. i. et ii.

sonous in other months: to the truth of which, in the few instances I have seen, I can vouch, though it is a generally-received opinion that they are most inimical in the hottest weather*. But this discrepancy, as to the time when mussels are or are not deleterious, is immaterial; for, except in those cases occurring from idiosyncrasy of habit, I believe that every instance of their poisonous effect would, if it were traced, be found to arise from their being tainted, or from some one or more of them being so, and intermixed with those that were fresh. Nothing can be more probable than such accidents; because a great number being generally dressed together, and mingled in the same dish, the detection of one or two tainted, among so many, would be very difficult. Of course, the hotter the weather, the greater the probability of tainted fish; and hence the more frequent occurrence of poison from fish in the summer months.

The *Tetrodon ocellatus* abounds on the coasts of China and Japan. It is accounted very delicious by the inhabitants of the latter country; but it is known to be so poisonous, that the military are forbidden, by a royal edict, from eating it. But others partake of it largely if it be gutted and cleansed, and eaten as soon as caught: but, if *not fresh*, it is highly dangerous†.

When we have the concurrent and unsuspected, because fortuitous, testimonies just enumerated, of Quieros, Forster, Thomas, Clarke, Chisholm, Quarrier, and Kœmpfer, that the same fish, when eaten fresh, or having no marks of disease,

* The Editor of the *Gazette de Santé*, March 21, 1815, asserts, that mussels possess deleterious qualities in humid weather only; and that he never observed any ill effects from them in dry weather. The cases detailed by *Dr. Rony* in this publication occurred early in *March*. It is possible, owing to the comparative coolness of the month, that the mussels were but slightly tainted; and, therefore, in the worst of the cases, some of the most marked symptoms of fish-poison, such as nausea, tormina, and diarrhœa, were not present. It is not wonderful that poisoning from mussels is, as said, frequent in Paris, a city situated a hundred miles inland, and where all fish are brought to its market by land-carriage.

† Vide *Kœmpfer's History of Japan*, vol. i. p. 134, 135.

were not only harmless, but even wholesome; and that the same, and even parts, though salted, of the same innocuous fish, on the following day, were highly poisonous, doubts if this poison exist in the healthy living fish are surely justifiable: and upon such authorities impartially selected, and I know of none that invalidate them, I presume to infer, that this poisonous property exists in, or is entirely dependant on a morbid condition of the fish that communicates it*.

7. *Is it a poison, sui generis?*—Where nothing is certain, and there are no data from which clear deductions can result, theory may not only be tolerated, but be commendable; for what is theorizing but the exercise of our thinking faculties, that prompts to practical illustration, and the perfection of human exertions? I have attempted to shew, that the opinions hitherto entertained of the seat, causes, and nature of fish-poison are erroneous. What then is the nature of fish-poison?

Many facts have been adduced, that, I think, must incline any one to suspect at least, if not to coincide in my opinion that this peculiar virus neither exists in, nor is the product of a sound and healthy fish; consequently that it is never found, excepting when fish have undergone some morbid change, in which state the properties of the animal are altered.

The flesh of fish is in all temperatures prone to a more rapid decay than that of warm-blooded animals. It is certainly very probable, that if a fish be caught in this unhealthy condition, it will, upon exposure to an intense degree of atmospheric heat, be more liable to sudden decomposition or putrefaction than one that is sound; and the rapidity of this decomposition will, in a great degree, be regulated by its state

* Since the original publication of this paper, I have been favoured with information from *Mr. Crampton*, the Surgeon-General of Ireland, that some years since an old gentleman ate heartily of some cockles, from which he experienced no inconvenience; but repeating the meal, on the *following* day, he was attacked with all the symptoms described as usually arising from fish-poison, and expired in about sixteen hours. These cockles were purchased of a woman who supplied the town where he resided, situated above forty miles from the sea, with shell-fish. This case adds further support to the inferences deduced.

of health. A sick fish, therefore, would exhibit its deleterious properties, though eaten immediately it was caught; while a healthy one will be wholesome on the first day, prejudicial on the second, and on the third produce virulent effects. So far as accounts can be relied on, and I have quoted some that I think strongly support the inference, it is manifest, that the deleterious qualities of fish, if not originating with the extinction of life, yet certainly then become considerably more active, and actually increase with the time the fish is kept. The proof of this is easy of experiment.

By certain chemical operations, various substances have been discovered in animal matter, that are only evolved and detected by the processes employed. Putrefaction is a natural chemical operation, during which many substances are disengaged and new properties evolved, which were before latent and combined. To produce these results, a certain quantity of heat seems requisite. Some of these products of animal matter, such as prussic and fluoric acid, &c. have been proved to be most potent and active poisons when applied to the living animal. May not, therefore, the bodies of fish in the elaboratory of Nature experience certain chemical combinations or decompositions during their putrefactive process, the educt of which is a property, *sui generis*, denominated fish-poison? CULLEN actually says, that "their putrefaction is with different circumstances from that of hot-blooded animals*."

It may be objected, that different kinds of meat and fish in a highly putrid state, are eaten in different parts of the globe, and with impunity; and, therefore, the deleterious qualities of fish cannot arise from common putrefaction. Unquestionably, something more than what takes place in the process of putrefaction in temperate climates is required, to account for this peculiar virus. It is remarked, that the instances of poisoning from fish are chiefly confined within the tropics; or at least that the poison in those latitudes is most virulent, and

* Vide *Materia Medica*, vol i. p. 388.

found in the greatest variety of fish. But be it remembered, that, nearest the equator, organized nature is most powerful and active, the temperature is highest, and the sun there produces effects very remarkable and different in many respects to those experienced in the temperate zones*; and the higher the temperature, the more rapid is putrefaction; provided the heat be not so intense as to reduce the animal body to siccidity.

In high latitudes, therefore, may not some occult property be evolved in the decomposition of fish, that is never an educt of those found much beyond the tropics? except in mussels, and incidentally in other shell-fish; but in which latter case the effect is rather ascribable to constitutional pre-disposition in the person eating them, than to any thing peculiar to the animal.

Are there no circumstances that, independent on the food of fish, conduce to explain why this property may be almost confined to the fish of tropical seas?

The temperature of the surface of the ocean near the equator is generally within a few degrees of that of the atmosphere, and is many degrees cooler than on shore: deeper in the sea it varies, but is always much lower than on the surface. Fish that are just caught in those latitudes are usually exposed to an atmosphere highly rarified, and a heat frequently above 100° of Faht. under a vertical sun, and, when landed, are placed over a highly reverberating soil. In tropical seas, a temperature of fifteen degrees below that of the surface of the ocean, and often of forty degrees below that on the land, is experienced. Hence

* That heat in the same parallel of the two hemispheres produces very different effects on the human body, is singularly apparent on the skin of the inhabitants. Within the tropics, in Africa, &c. the skin is of a sooty black; but in South America, even under the equator, its colour is not darker than in the people of some parts of Europe. This may, perhaps, be geologically explained. But the heat of some parts of South America is as intense as that experienced in many parts of Africa or Asia: yet the complexion of the inhabitants of the former is uniformly of the same colour. May not the effects of heat in the South American seas, from a cause equally inexplicable, evolve a property in some fish which is rarely found in the fish of the seas of the opposite hemisphere, though within the tropics?

the putrefaction of fish caught there and exposed to the atmosphere, must commence with the extinction of life, and proceed with a degree of rapidity much greater than that of warm-blooded animals; though even they, in the torrid zone, are known to become putrid in a few hours after they are killed.

The reverse takes place in the more temperate seas, and even in those of cold climates. Taken at the mean of a year, the temperature of parts of the European seas is higher than that of the land, and in the Lapland seas, in lat. $70^{\circ} 40'$, in the month of May, when the air was 27° Faht. the surface was 36° ; and at the depth of 90 fathoms, it was 39° *. The temperature of the water of the British seas never descends below 28° ; consequently when fish are taken from seas warmer than the atmosphere, they will be long prevented from putrefying, by being in a temperature actually lower than their natural element. And if fish be placed in a still lower temperature, that is in ice, we know they will keep sweet longer, and may be conveyed from a great distance to market.

As fish, therefore, immediately they are caught in tropical latitudes, are placed in such very high degrees of temperature and to the action of the sun, the rays of which are known to cause a greater intensity of heat and a peculiar action, I infer, that, between the tropics, a change takes place in character and effects dissimilar to what attends the process of putrefaction in more temperate climates; and hence a property is produced which is the poisonous quality of fish.

Upon an attentive revision of what has been adduced, I am led to the following corollaries—1. *that the poison of fish is not confined to any particular part of the animal*—2. *that it does not arise from the food of fishes*—3. *that no fish partakes of this property, unless it have undergone some morbid change*—4. *that this property is a poison, SUI GENERIS, always most active after the vital powers cease.*

* Vide *Phil. Trans.* vol. lx. p. 39.

REMARKS ON THE ANTIDOTAL OR CURATIVE MEANS.

WHEN our knowledge of the nature of any substance producing a specific and dangerous action on the animal economy is so limited, we cannot expect to establish any very accurate theory, either of a prophylactic or curative plan of treatment. The success of preventive measures must wholly depend on an accurate knowledge of the nature of the poison; and as we are yet ignorant of what fish-poison is, no rules can be laid down on which there is any reliance*: the cure may, perhaps, be more certain, from experience of the means which have been resorted to for relief.

Instances of the malign effects of fish-poison are so numerous, that we possess a tolerably-accurate diagnosis; and, as far as information warrants, if remedies be administered in proper time, the prognosis may be equally certain, and is generally favourable.

It would be tedious, and probably useless, here to enumerate minutely all the symptoms attending the eating of venomous fish: they may be collected from many writers. I will, therefore, be succinct in my account; and as briefly as possible detail what are the most efficacious modes of relief, and the remedies recommended: and if I venture to offer any conjecture on the rationale of their operation, it will be with the hesitation of one who has not experience for his guide.

When fish has been eaten, and in an hour or two afterwards a weight at the stomach, with nausea and an approach of slight vertigo, are felt, with universal uneasiness, or a numbness of any particular part of the body, constriction of the throat, a sense of heat about the head and eyes, immoderate thirst, and an eruption and itching of the skin, it may be justly concluded such symptoms are the effects of this aliment.

Nature generally spontaneously relieves herself of the ob-

* As a prophylactic measure, *M. du Rondeau* recommends the dressing of mussels in vinegar and water, and a little Cayenne pepper; and he asserts that if they be boiled in this mixture, it infallibly prevents any ill effects from them: but boiling them in water only does not deprive them of their poisonous quality.

noxious food; especially if mussels be the cause of offence. The most judicious and obvious mode of acting is, therefore, instantly to free the first passages by an emetic, and afterwards by the operation of an active purgative. If the unfortunate youths at Gravesend had been so treated, as Mr. Rogers judiciously proposed had he seen them in time, or had the fish been evacuated by any natural efforts, instead of being retained twenty-four hours before complaint was made, their lives would doubtless have been preserved. Persons may be so situated, upon feeling the symptoms described, as not to be able immediately to procure any remedies. In this case it will be expedient, and easy, to irritate the fauces with the finger or a feather, till full vomiting be excited; and other means may then be safely deferred until opportunity offer of evacuating the bowels.

The drinking of vegetable acids, such as vinegar, the citric acid diluted, or lemon or lime juice, and washing the body externally with vinegar and water when it is covered with the eruption, are recommended on good authorities. But when early measures for removing the cause from the stomach and intestines have been neglected, and the poisonous food has been in part assimilated and introduced into the system, various other symptoms follow, that require treating according to circumstances and the situation of the patient. On this part of the subject Dr. Chisholm speaks with some confidence, from the result of his own experience. He recommends, where morbid changes have been produced as the *sequelæ* of the effects of fish-poison, a solution of alkalies in water. If spasm ensue, after evacuations, laudanum, in considerable doses, is necessary. Sometimes the soles of the feet have a peculiar and distressing sensation, which is best relieved by soaking them in alcohol or wine; and occasionally also a kind of pus forms under the skin, which separates: he then has recourse to the bark, and, as an external application, the vegeto-mineral water. But when the effects produce ulceration of the body, and paralysis, he orders mercury, pushed to salivation, and bark and wine.

Dr. Clarke, of Dominica, prescribes, as an antidote, Cayenne pepper; others, spirits of wine: but these must be con-

sidered as condiments which stimulate the digestive organs, and excite them to resist the effects of obnoxious aliments, rather than as acting specifically on the poison.

I have already (page 18) noticed that *sugar* has been exhibited by Mr. Stevenson, late of St. Kitt's, as an antidote for fish-poison; and that the same substance is recommended by *M. Orfila* to counteract the effects of cupreous poison: but although it cannot from this circumstance alone follow that cupreous and fish-poison are the same, yet it is in itself a very curious and singular coincidence in practice, and merits particular attention. In the paper, on the deleterious effects of mussels, in the *Gazette de Santé*, to which I have before referred, there is also mention made of remedies which have been found highly serviceable in such cases, that may by some be considered as supporting the efficacy of sugar as an antidote to fish-poison; although the French physicians have employed it as a mere vehicle for other medicines, to which alone they ascribe the relief experienced. The editors declare, that in many of the cases they have seen of this nature, large doses of æther have immediately removed all the troublesome symptoms. They advise that 20, 30, or 40 drops should be given, on a piece of *sugar*, every half-hour, or that three or four drachms may be mixed with *syrup*, and a spoonful be taken at intervals till the symptoms abate. Now a question may arise, whether the relief afforded should be attributed to the action of the æther, as a stimulus, or to a peculiar antidotal property of the sugar. *Dr. Rony*, in the case to which these observations of the editors apply, says, he administered brandy in some infusion (*animée*); but that it afforded *no* relief; and that he then gave sulphuric æther in *sugared water*, which *did* produce some relief, although it was momentary. It will be observed that *Dr. Rony* did not exhibit the brandy with any form of sugar, and the mere stimulus of the spirit was then *inefficient*; and when a spirit (æther) was joined with sugar, in a weak solution, some good, though transitory, was obtained; but when the spirit was combined with *sugar* in the more concentrated forms of crystals and of syrup, the relief was complete.

I will not attempt to decide, whether the beneficial result is to be attributed to the sugar or to the æther, or what is the *modus operandi* of either substance. The accidental exhibition of *sugar* in these cases, with the positive evidence of Mr. Stevenson of the success attending the drinking of the sugar-cane juice, or of the sweet potatoe; and the result of the experiments reported by the learned and ingenious *Orfila*, on sugar as an antidote to the metallic poison of copper, and even to that of arsenic also, are facts highly important, and deserve serious investigation.

It has been said, that if *salt* be applied to fish, any poisonous quality it may possess is corrected. But this is not true; and an unlimited confidence in salted fish might produce great inconvenience, if not fatal consequences. Salt did not prevent fish from poisoning Captain Cook's men; and other instances are likewise recorded, shewing that this substance does not correct the poisonous quality, if it really exist in the fish at the time of being submitted to that mode of preparation.

What are the signs by which to ascertain whether a fish be wholesome or poisonous, it is quite impossible, in the present extent of information, to determine. But there are certain indications by which it is evident the danger may be frequently observed, and of course avoided. Long experience ought to teach the inhabitants of the torrid zone, that the fish of the seas that surround their shores, found at one period wholesome and at another dangerous, undergo natural changes, which are in reality morbid conditions; and that then the probability of their being more deleterious is increased. If the accounts which I have quoted be correct, and there exists no reason to distrust them, poisonous qualities are never connate with nor present in any healthy fish, but are always consecutive to a state of disease; or, what is more probable, are acquired after the animal is dead; and that the activity of the poison augments as the period is protracted from the fish being caught to its being eaten. Fish, therefore, should not be dressed when there is an evident deviation from a healthy state. Whether the propensity to this property be general or applicable only to particular fish, or whether it be

adventitious, can only be satisfactorily elucidated by future inquirers.

Dr. Chisholm seems to think that chemical experiments can be seldom recurred to, in the West Indies, with a successful result. This in part is certainly true; and particularly in the prosecution of animal chemistry. But such an observation should have been in some degree qualified; because, having his authority, it is likely to be received in its most extended sense; the spirit of research be thus checked, instead of being encouraged; and the productions of Nature, which in those prolific regions assume such interesting and imposing, because novel, forms, would remain neglected and unexplored. This remark is the less excusable, since, though it may apply to experiments on animal, and in some sort on vegetable matters, yet it is no objection to the analysis of mineral substances; and in this very passage Dr. C. acknowledges himself disposed to consider the basis of fish-poison to be metallic*.

If copper were the basis of this poison, and it were in sufficient quantity either in the first passages, or in the substance of fish, to destroy other animals, surely the employing of the known common tests of the presence of this metal, would have been facile and demonstrative in all situations. The addition of a small quantity of pure ammonia would, if copper were present, give the usual blue tinge to the contents of the stomach of the fish, or to the water in which it was boiled; or if a piece of bright iron were immersed in the suspected matter, it would instantly become coated with copper. These obvious and simple experiments might have been tried; but I cannot discover that even this has been done by any one inquisitive person.

As to the experiment of boiling a piece of silver, or an onion, with a suspected fish, as a test, and pronouncing that it is wholesome if these substances be unchanged, and that it is poisonous if they turn black; it is one liable to be affected by so many extraneous circumstances, that a reliance on it would

* Vide *Edinburgh Medical and Surgical Journal*, vol. iv. p. 419.

be hazardous in the extreme: as indeed is proved by Dr. C.'s own statement.

The powers of CHEMISTRY are wonderful, and to analysis we are indebted for a rapid and more intimate acquaintance with elementary principles. Many substances hitherto unsuspected have, either by accident or by art, been detected in the animal, vegetable, and mineral kingdoms; some of which are discovered to be most virulent poisons, and become instantly fatal to animal life. How recently is it that we have known the existence of the prussic acid in such a variety of substances; still more so that the fluoric acid is to be found in bones, teeth, and urine, or that such an extraordinary substance as *Iode* is latent in the ashes of sea-weeds*?

Were it established that this poison is not innate in fish, but consecutive to disease or to the extinction of vitality, its examination would be easy to all who frequent the West Indies, where poisonous fish are most numerous; and its nature would surely be easily developed by chemical tests. CULLEN, in treating of aliments, slightly alludes to the omission of this inquiry, and suggests a hope, that the nature of fish-poison would in this way be examined. As animal chemistry is now a favourite pursuit of philosophic chemists, we may hope that their attention will be extended to a subject on many accounts so interesting.

* *M. Gaultier de Claubry*, in his analyses of different *Fuci* and of Sea-Water in search of *Iode*, (*Vide Journ. de Physique*, *Fevrier* 1815,) found in the *fucus saccharinus*, which affords the most of this substance, both acetic and prussic acid, the latter of which is one of the most active of poisons on animals. This acid is a component of animal and of various vegetable substances, as of the *lauro cerasus*, bitter almonds, and of various drupaceous fruits. Distillation is always essential to the concentration of this principle in the first, and in the second substance also to produce fatal effects; yet, from eating bitter almonds and stone fruits, (*Vide Med. Facts and Observ.* vol. v. p. 57,) analogous but effects less violent have resulted, especially in hot climates. As the presence of so deleterious a poison is known to exist both in animals and vegetables, even in those to which sea-water is the *pabulum vitæ*, and is likewise concentrated by very different degrees of heat, why should not the prussic or some other poison be evolved from fish at that degree of temperature to which, when taken from the deep into the atmosphere of the torrid zone, they are suddenly exposed?

The French philosophers, as I have said, who drew up Peyrouse's instructions, directed their views to this inquiry; but that unfortunate navigator effected but a small part of their intentions. Even Labillardiere, who, as a naturalist, accompanied D'Entrecastaux when he was sent out to discover Peyrouse's fate, and complete what he had left unfinished, has not touched on it. Considering it both important and curious, it is very singular that those learned and able naturalists and travellers, Humboldt and Bonpland, in traversing the tropical seas, should have totally neglected it. Mr. Peron, in his voyage to *Terra Australis*, with able naturalists, to examine and report on objects of natural history, has contributed nothing to our knowledge of this remarkable property of fish.

To judge from the contents of the first volume of *M. Orfila's* interesting work on *Toxicology*, some expectation may be entertained that in his next, when treating of animal poisons, he may offer something satisfactory on the nature of fish-poison.

Happily in this country, or indeed in any part of Europe, serious effects from fish-poison are of rare occurrence, and are chiefly confined to mussels—a food generally resorted to more from choice than necessity; and which, therefore, if dangerous, may be avoided. On this ground some writers have treated the subject lightly; and because the cases were few, and the recoveries considered certain, have pronounced it of too little importance for particular notice. But the cases of the Pearsons, of Captain Vancouver's man, and of others, evince that, if from ignorance of the symptoms of fish-poison, or from neglect or necessity, proper means of relief are delayed, the most deplorable and unhappy consequences may ensue. The same reasoning also applies, and suggests the vast importance of some clear and definite knowledge of the nature of fish-poison to those venturesome navigators of the boundless deep, who, led by a love of science or spirit of enterprise, have often anxiously looked for and relied on a supply of fish to relieve their wants, or for refreshment; and have had reason to rue their ignorance

and rashness. History furnishes many examples of the danger to which the crews of various vessels have been exposed for want of some guide to distinguish edible from venomous fish ; where, if life has not been the forfeit, years of suffering have been entailed on them. The utility, therefore, of the inquiry must be acknowledged. If novelty be an inducement, it has that incentive ; if the love of fame operate, the discoverer's name would be enrolled high in the records of science.

From the preceding observations it will be evident, that I have attempted rather to correct and disperse existing errors, by arranging and displaying all the information that I could collect relative to fish-poison ; than to offer any decided opinion of my own on its nature, its effects, or the curative mode of treatment. Enough has been stated, to open a wide field of inquiry, and awaken research. I willingly leave to the experience of others, the chastening of my hypotheses ; and shall bow with deference and respect to those, who, enjoying and embracing practical means, condescend to notice them, even though they may prove their fallacy.

The judicious application of a little knowledge, stimulated by an inquisitive spirit, with opportunity and industry, have surmounted greater difficulties than appear to be attendant on this investigation ; and have led to the establishment of truths that have promoted the arts, ennobled science, and proved highly beneficial to society.

and reason. History furnishes many examples of the danger to which the cause of virtuous men have been exposed; and the want of some guide to distinguish noble from venious men; where, if he has not been the fortuitous, years of suffering have been entailed on them. The utility, therefore, of the inquiry must be acknowledged. It is not to be an inducement, it is not that incentive; it is the love of true science, the discovery of names would be enrolled high in the records of science.

From the preceding observations it will be evident, that I have attempted rather to correct and disperse existing errors, by arranging and displaying all the information that I could collect relative to this subject; than to offer any decided opinion of my own on its nature, its extent, or the tentative mode of its removal. Though I have been able to open a wide field of inquiry, and awaken research, I willingly leave to the experts the task of clearing the uncertainty of my hypotheses; and shall bow with pleasure and respect to those who, enjoying and embracing practical means, condescend to notice them, even though they may prove their fallacy.

The judicious application of a little knowledge, stimulated by an inquisitive spirit, with opportunity and industry, have produced greater difficulties than appear to be attendant on this investigation; and have led to the establishment of truths that have promoted the arts, enriched science, and proved highly beneficial to society.