been so, that in animals with a heart so imperfectly divided, the blood sent to the lungs would be necessarily a mixture of venous and arterial fluid, and similarly that the blood distributed by it to all the organs and parts of the body is alike a mixture of pure and impure fluid.

In fact, however, this is by no means the case, and in the frog, in spite of the reception into a single chamber of both venous blood from the body, and of arterial blood from the lungs, special mechanical arrangements effect such a definite distribution of the two sorts of blood, that the unoxygenated fluid from the body is sent to the purifying respiratory surfaces (lungs and skin), and that the pure oxygenated blood alone goes to the head and to the brain.

For the detection of this beautiful mechanism, we are indebted to the careful investigations of Ernst Brücke.*

The heart of the frog consists of a right and left auricle (divided by a delicate septum), both opening into a single ventricle. From the latter proceeds an aortic root (bulbus aortæ) which gives rise to three arterial trunks on each side.

The first of these, or carotid trunk (1), ends in an enlargement (*a*) termed the carotid gland, of spongy structure, which gives rise to two arteries, one the lingual (*l*), the other (*c*), the carotid which goes to the head and brain.

The second, or systemic trunk (2) meets its fellow of the opposite side beneath the spine, and thence passes backwards as the great dorsal (in man descending) aorta, giving off arteries to all parts of the body.

The third, or pulmo-cutaneous trunk (3) ends by dividing into two arteries. The anterior of these (*r*) goes to the skin (which, as we have seen, is in the Frog an important agent in respiration), the posterior one (*p*) goes to the lungs.

The heart itself is of a more or less spongy texture, but the main cavity of the single ventricles open at its extreme right into that of the aortic bulb (*c*). In close proximity to the opening are the openings from the right (*b*) and the left (*a*) auricles respectively.

The aortic bulb is constitutionally divided by a movable septum (Fig. 77, *s*) in such a way, that the passage on the right side of it leads to the carotid and systemic arterial trunks, while the passage on the left side of it leads to the third pair of trunks—namely, those ending in the pulmonary and cutaneous arteries; moreover, there is a valve in the first of these two passages which tends to retard the flow of blood (*v*).

The consequences of these arrangements are as follows:—

When the auricles contract, the venous blood from the right auricle (*RA*) is sent into both right and left passages of the bulb, but by the action of the valve (*v*), and by the structure of the carotid gland, the blood is checked on the right side (*ip*), while on the left it runs freely into the pulmo-cutaneous trunks (*r* and *p*), and thus the respiratory structures receive unmixed venous blood for purification.

As the lungs get gorged with blood, the resistance on the two sides of the septum of the bulb becomes at first equalised and soon becomes the greater on the left side; then the septum is forced over to the left, and the blood, now mixed with pure blood, flowing in from the left auricle, flows freely along the systemic arteries (2 and 2). The obstruction of the carotid glands (*c gld*) being the greatest and the last to be overcome, the carotid and lingual arteries (*c* and *l*) receive the very last of the blood—that, namely, which coming from the left auricle is purely arterial—and in this way oxygenated blood only is supplied to the head, sense organs, and brain.

It should be borne in mind that in order to develop this most beautiful and complex apparatus, the co-ordinate development in due proportion of these beneficial obstructions and checks must have been simultaneously effected in order that their purpose should be duly served. In other words, to account for its formation by an indefinite series of minute happy accidents would seem to require such a successive occurrence of coincidences as to become an improbability so great as to be indistinguishable from impossibility.

ST. GEORGE MIVART

(*To be continued.*)

* "Beiträge zur vergleichenden Anatomie und Physiologie der Gefäss-Systemes." In the third volume of the "Denkschriften der Mathematisch-Natur-wissenchaftlichen classe der Kaiserlichen Akademie der Wissenschaften." Vienna: 1852.

THE "CHALLENGER" EXPEDITION

BERMUDA

FROM the two visits made by the *Challenger* to Bermuda we learn a good deal about the vegetation of that island. Along the coast, which in some parts is irregular and rocky, and in others of a sandy nature, frequently with heaps of drifted sand, may be seen in abundance a species of *Borrichia*, a low shrub belonging to the compositeæ, *B. arborescens* D.C. being common in the West Indian Islands, and noted for having both glabrous and silvery leaves on the same plant, as well as the two forms on separate plants. In close proximity to the *Borrichia* was seen *Tournefortia gnaphalodes* R.Br., a Boragineous shrub from 2 to 6 feet high, with white flowers and downy leaves, and *Ipomœa pes-capræ* Sw. with its long stem, which frequently creeps to 100 feet or more, and its purple flowers. In the crevices of the rocks grow *Euphorbia glabrata* V., a shrubby glabrous plant common to the West Indies, and on the shores of Florida, Honduras, &c. A species of Tamarix is also abundant, as well as *Conocarpus erectus* L., and *Coccoloba uvifera* Jacq., known in the West Indies as the seaside grape, from the violet-coloured, pulpy acid-flavoured peiranth; an astringent extract like kino is likewise prepared from the bark, and the bark itself is used for tanning leather.

Many trailing plants scramble about on the sand dunes, assisting to bind the loose sand together. Amongst the most important of these is a hard, prickly grass, probably a species of *Cenchrus*, *Cakile æqualis* L'Her, a singular cruciferous plant allied to our Sea Rocket, and a species of *Scævola*. The Mangrove (*Rhizophora mangle* L.) occurs in swamps similar to those which have been so often described by travellers; but beside the true mangrove swamps, there are others occupied by trees of *Avicennia*, *A. nitida* Jacq. being known in the West Indies as the black, or olive mangrove.

In the peat bogs, or marshes, which are surrounded by low ranges of hills, the most striking character of the vegetation is the ferns; species of *Osmunda* are abundant, as well as *Pteris aquilina* L. Some of the marshes, however, have their special character of fern vegetation some species, as for instance *Acrostichum aureum* L. (*Chrysodium vulgare* Fee), being found only in particular spots. The Junipers (*Juniperus bermudiana* Lun.) also thrive in the marshes, but none of the trees at present standing approach in size those that are occasionally found below the surface. These large trunks usually lie at a depth of about two feet. The average diameter of the trunks of existing trees may be taken at from two to three feet, and these are mostly unsound in the centre owing to the marshy ground in which they grow. The largest known living trees in the island measure respectively fifty-nine inches and thirty-nine inches in diameter; the first is hollow, but the second is apparently sound. Amongst other noticeable marsh plants are *Myrica cerifera* L., a shrub the berries of which, in Central America, yield wax from which candles are made, and *Rhus toxicodendron* L., the Poison Oak of North America.

In the fresh-water ponds or lakes inland, some of which are a quarter-mile long, and often are in close contiguity to a peaty marsh, though the waters appear not to be affected by the peat but are said to be salt at certain periods, occur abundance of confervæ and minute algæ, as well as a species of *Ruppia*. In the shady damp hollows, at the entrances of the caves, is usually seen a rich growth of ferns, jessamine, and coffee trees of good size.

The general features of the indigenous vegetation of the islands are the Junipers, *Lantana camara* L., a verbenaceous shrub which grows in dense masses, and the Oleander, which also grows in abundance and is used for hedges. A few trees of the Date and Cocoa-nut palms may occasionally be seen, but their fruit produce is not sufficiently abundant to be of any importance. One of the greatest pests in the island in the form of a weed is *Leucœna glauca* Bth., which sends down its tap roots to a great depth, and is difficult to eradicate. It is a leguminous plant, and in its native state forms an ornamental tree.

The least cultivated part of the island is at Paynter's Vale, where orange and lemon-trees luxuriate in their wild state. From the prevailing dampness of the atmosphere all over the island, a species of Nostoc abounds not only in the caves and on the rocks near the seashore, but also amongst the roots of grass on lawns. Out of about 160 flowering plants collected in Bermuda *Morus rubra*, *Hibiscus arborea*, and *Chrysophyllum cainito* are the only three that do not occur in an absolutely wild state. Perhaps not more than 100 are true Bermuda plants. Many of the plants of the island were no doubt originally brought from the West Indies by the Gulf Stream, or the cyclones. The presence of American plants is perhaps to be traced more to the migrations of birds, which come in large numbers, more especially the American Golden Plover. Then, again, to account for the presence of other plants, there is the fact of the annual importation of large quantities of hay, and also of seeds, such as onion seed from Madeira and potato seed from America, with which other seeds are, no doubt, constantly introduced. Shipwrecks, also, which occur on the coast, are probably fruitful sources from whence new plants arise; as a proof of this, it is stated that a vessel with a cargo of grapes was recently wrecked and the boxes of grapes washed ashore, the seeds of which, being saved, were sown, and produced an abundance of young plants.

INDUSTRIAL CHEMISTRY

THE Society of Arts seems to be increasing its efficiency every year, "lengthening her cords and strengthening her stakes;" quite recently a Chemical Section has been added, which we believe will be productive of much practical benefit. At the opening of this Section on the 6th inst., the chairman, Dr. Odling, gave a valuable and interesting address, which, by the courtesy of the secretary of the Society, we are able to present to our readers :—

I have been desired by the Council to say a few words at this introductory meeting on the importance of Industrial Chemistry, but really to do so is to urge upon you a theme which requires no advocacy, I should think, on the part of anyone, and I am afraid it would be as tedious as thrice-told tales. If we look at the objects with which we are surrounded and consider how very few of them are in a state in which they are presented to us by nature, we shall find that the metamorphoses to which they have been subjected are essentially chemical ones; that is to say, wherever we find one kind of matter in nature, and somehow or other the matter is turned into another kind of matter, we submit it to a chemical change; and how very few indeed of the different kinds of matter with which we are surrounded are really in their primitive forms. When we have mentioned wood and stone, I mean building stone, we have mentioned almost all. When we consider the gas which, though now gas, was a short time ago in the form of coal, or the glass of our windows which a short time back was in the form of sand, soda, and limestone, or if we look at the plaster of our rooms, which was originally limestone, which has undergone varied metamorphoses, and more particularly I might direct your attention to the metallurgical industries, especially iron, which was a short time before in the ironstone—all these are instances of the chemical metamorphosis to which we subject the different natural objects, and so change one kind of matter into another.

Among all these metamorphoses which are of a chemical nature there are some to which we more particularly apply the name of chemical manufactures. In reality, a brick is as much a product of chemical change; it was not originally the same matter it now is, but was produced by a change of chemical composition of its elements. But among these more particularly called chemical manufactures, the production of which is conducted in works which are called chemical works, are those performed in so-called alkali works; and I think I need have no hesitation in saying that these works have proceeded to a far greater development in this country than in any other, notwithstanding the fact that among the constituents received and metamorphosed by these works are many which are of foreign extraction, more particularly the pyrites, or other sources of sulphur, and the manganese or other sources indirectly of the chlorine manufactured at these works. And we see, that in the course of lectures which has been provided for us, three have reference especially to these manufactures, which are conducted exclusively at works which are denominated chemical works. We have a process for the manufacture of soda by Mr. Vincent; another on pyrites, as a source of sulphur, copper, and iron, by Dr. Wright; and another on the manufacture of chlorine, by Mr. Weldon.

Starting from the crude substances, coal and limestone, and pyrites and common salt, we have a production of soda which will be treated of more particularly in Mr. Vincent's address. Then we have the further manufacture of copper, sulphur, iron, and chlorine, which are the necessary economical concomitants. It is indeed remarkable, at the present day, how much the production of chemical manufactures takes in the working up of what were formerly waste products. Perhaps we could not have a more singular instance of this than in the utilisation to which that class of refuse, which was formerly known as burnt pyrites, is now put. Not only do we obtain from the original pyrites sulphur in a form which was formerly thrown away on a very large scale, but, moreover, copper and iron, which were also formerly thrown away in the burnt pyrites. And we have also one very remarkable product now obtained from pyrites on a comparatively large scale, and I may say, with regard to the manufacture of copper from pyrites, that the amount now produced—as Mr. Wright will tell you—from a material which was formerly thrown away, constitutes a very large proportion of the entire quantity now manufactured in the United Kingdom.

But in addition to that there is a very considerable manufacture of silver now going on also extracted from these waste pyrites. This extraction of silver from these pyrites, in which it occurs in an exceedingly minute proportion, has an essential interest for chemists in this point of view, that the processes which are adopted for its extraction really resemble most closely the processes which purely scientific chemists adopt in the laboratory. The pyrites are first of all heated with common salt, whereby the copper is converted into chloride of copper soluble in water, and the silver into the state of chloride of silver, which is soluble in the common salt solution; and not only so, but in this process of removing the soluble copper and the soluble silver from these pyrites,