and of uniform structure throughout. Two of the latest investigators, Max Schultze and Ofsiannikof, assert directly opposite opinions upon this point. Whatever they be, however, it is at least certain that they possess a definite term of life. They are incessantly being formed in the chyle and lymph, and also probably in the liver and some other glands. And after the completion of their work, they disappear or are destroyed, this destruction being seen most remarkably in the liver, and in the blood which has traversed muscular tissue.

The chief function of the blood-corpuscles in the body has long been known, or, at any rate, strongly suspected. They are the carriers of oxygen, the agents of oxidation, in the animal body. During its passage through the lungs, the blood, as every one knows, loses carbonic acid and takes up oxygen. Every 100 volumes of the blood which enters the lungs is capable, according to Claude Bernard, of absorbing twenty-one volumes of oxygen. This is about seven times as much as an equal quantity of water could dissolve, and Berzelius, long ago, showed that serum which differs but slightly from liquor-sanguinis, was hardly superior to water in this respect. Consequently, it is evident that the great mass of the oxygen must be attracted by the blood-corpuscles. The corpuscles, as before mentioned, constitute about one-half of the bulk of the blood, and, therefore, allowing for the small quantity dissolved by the liquor-sanguinis, we find that they absorb thirty-nine per cent., or thirteen times as much oxygen as water could. That this oxygen is combined in, and not merely dissolved by, the corpuscles, is indicated by the fact observed by Bernard, that pyrogallic acid, a substance that combines eagerly with free oxygen, when it is injected into the veins, will pass out of the body of the animal without undergoing oxidation. It has, therefore, been generally assumed, although upon imperfect proof, that the colouring matter of the corpuscles was capable of combining with oxygen in the lungs, and afterwards of giving that oxygen out again—in small doses, as it were—to the substances to be oxidized. This notion has been recently raised to the dignity of a theory by some beautiful experiments which physiology owes to a physicist—Professor Stokes, of Cambridge. Stoke's researches appear hardly to have received from physiologists the attention they deserve, and I, therefore, venture to present a brief description of them here. Hoppe-Seyler had previously recorded the curious fact, that when a ray of white light passes through a weak solution of blood, and is afterwards decomposed by a prism, two dark bands make their appearance in the green portion of the spectrum. Stokes repeated and verified the fact, and it soon became in his hands the starting point of a new train of research.

He treated a solution of blood-corpuscles with an alkaline reducing agent, and observed that its colour almost instantly changed from scarlet to purple-red, the hue of veinous blood. On examining the spectrum, he now found that the two dark lines had disappeared, and that a single line, intermediate in position between them, had become visible. On shaking the tube with air, the scarlet colour and the two lines at once returned, but after a few minutes, again disappeared; and this could be repeated many times. Hence it was evident that the scarlet arterial blood lost its oxygen to the reducing agent, and subsequently recovered it again, when shaken, from the air. The fact is so important that I prefer to give it in Stokes's own words. He says.

" The colouring matter of blood, like indigo, is capable of existing in two states of oxidation, distinguishable by a difference of colour, and a fundamental difference in the action on the spectrum. It may be made to pass from the more to the less oxidized state, by the action of suitable reducing agents and recovers its oxygin by absorption from the air."

Hoppe-Seyler had shown that this colouring matter is different from the so-called *hæmatin*, which is obtainable by artificial means from the blood, and Dr. Sharpey therefore suggested that the true colouring matter should be named *cruorine*. The name is a good one, and does not, like "hæmato-globulin," which is adopted by Hoppe-Seyler, involve any hypothesis. In the oxidized—the scarlet state—it is distinguished as *scarlet cruorine*, and in the reduced state as *purple cruorine*. It is hardly necessary to point out how intelligible an explanation these facts afford of the oxygen carrying power of the blood-corpuscles. In the lungs the purple cruorine of veinous blood takes up oxygen, and becomes scarlet cruorine; and in the whole of the general circulation, but more particularly in the capillaries, oxidation is effected by means of this oxygen, and the cruorine, to a great extent, passes back to the purple state. Hoppe-Seyler has since found that the blood of a rabbit which has been killed by drowning, exhibits the spectrum of purple cruorine. In ordinary states, however, even veinous blood retains enough unreduced cruorine to give the two-line spectrum.

But Stokes has discovered another fact which is of extreme importance in regard to the question of animal oxidation. He found that a solution of the blood-corpuscles from arterial blood —a solution, that is, consisting mainly of scarlet cruorine—when excluded from the air, slowly *reduced itself*, and showed, after a time, the purple colour and the one-line spectrum of purple cruorine. On opening the tube and shaking it with air the scarlet colour returned, and with it the two-line spectrum. Hence it is clear that scarlet cruorine is capable of oxidizing a portion either of its own substance or else of the serum, from which it is impossible wholly to free it in the experiment. Whichever it be, it certainly is a part of the blood itself which is oxidized by the cruorine; and this fact is, as we shall presently see, in perfect accord with the theory to which we are led by other considerations.

These curious optical experiments, apart from their physiological interest, have already yielded some practical results of considerable importance. Soon after the publication of Stokes's memoir, Mr. H. C. Sorby contrived an ingenious adaptation of the spectroscope to the microscope, and by its means succeeded not only in repeating all Stokes's experiments, but also in furnishing medical jurisprudence with a new and most valuable means of identifying blood-stains. The spectrum-microscope has since but somewhat improved in construction, and many readers of this journal have no doubt seen it, and the beautiful experiments which its inventor performs with it at some one of the recent scientific *soirées*. It is described in detail in a paper by Mr. Sorby, read before the Royal Society, April 11, 1867. A scrap of blood-stained fabric, 1-10th of an inch squar , containing possibly not more than 1-1000th of a grain of colouring matter, may be experimented upon by its means, and the most certain evidence of the nature of the colour obtained. It has already been found useful in criminal trials.

Another interesting application of the spectroscopic examination of blood was made by Hoppe-Seyler. Claude Bernard discovered, some years ago, that the poisonous action of carbonic oxide gas was due to the circumstance that it had the power of displacing all the loosely-combined oxygen from the corpuscles, and of occupying its place in a somewhat more stable form of combination. All blood, veinous as well as arterial, after treatment with carbonic oxide, acquires a uniform red tint, which it retains with singular persistency, being, in fact, as Bernard expressed it, *mineralized* by the gas. Hoppe-Seyler submitted some of the blood so treated to optical examination, and found that it gave a spectrum very similar to, but not identical with, that of scarlet cruorine. But when excluded from the air, instead of reducing itself like scarlet cruorine does, it remained unchanged for an indefinite period of time. Hence the process indicated a delicate and certain test for use in cases of suspected poisoning by carbonic oxide. I myself, in ignorance of Hoppe-Seyler's experiments, made the same observations. I have by me now a sealed tube, which has for more than a year contained a solution of blood through which carbonic oxide had been passed. The spectrum has not altered in the slightest degree (1).

(1) I believe reduced cruorine to be the most delicate, as it certainly is one of the simplest, qualitative tests for oxygen known. If a weak solution of blood is inverted in a test tube over mercury, it reduces itself in a day or two, and a small prism will then show the one-line spectrum. The minutest trace of oxygen will now restored the original spectrum; a single drop of distilled water will often contain enough. I obtained inci-