

on y voit naître les Bacteriums, les Vibrions, les Mucédinées &c.¹

Here there is no question of albuminoid particles combining to form an organism. If they develop here spontaneously they must be built up from mineral salts.

Such is Pasteur's first work—the work which is considered by many to have struck the final blow at heterogenesis. Let us see what it really does prove.

It shows that a certain number of boiled fluids prone to the development of organisms can be preserved, without any growth of organisms in them, in the presence of calcined air, or of ordinary air, the dust of which has been allowed to settle; that the introduction of dust into these flasks is the only condition requisite for the development of organisms; that the source of organisms is something discontinuous—particulate; that organisms are not necessarily the result of changes in albuminoid materials, for they grow vigorously in an artificial mineral fluid. Further, Pasteur has shown that among the particles present in the dust of the atmosphere there are spores of fungi and bodies which may be bacteria or their spores.

This is all that is *proved* by these experiments; and how does Pouchet answer them? By asserting that these solid particles are not bacteria or their spores, but lifeless particles, which under certain conditions become vivified, and appear as various forms of organisms? The only possible theory, one would think! No. Pouchet disputes the facts. He does not, it is true, take the trouble to repeat Pasteur's striking experiment of the flask with bent neck. He simply says: 'C'était une erreur.' Further, 'Nous avons refusé de répéter les expériences de M. Pasteur parce que, logiquement, rationnellement, pour des physiologistes, du moment où il est reconnu

¹ It may be mentioned here that, since Pasteur published, other similar fluids in which organisms can grow have been employed. Thus Cohn uses the following:—

Distilled water	20 c.cm.
Tartrate of ammonia	·2 grammes
Phosphate of potash	·1 "
Crystallised sulphate of magnesia	·1 "
Tribasic phosphate of lime	·01 "

que celles de Schwann¹ sont absolument erronées, et je pense que pas un seul de ceux-ci ne voudrait aujourd'hui le contester, les expériences du chimiste de Paris sont conséquemment frappées de la même nullité.²

Pouchet again returns to the simple experiment in repetition of Schulze's, which we have previously quoted, but now his statement is directly opposed to that formerly made. He now says, 'En employant dans cet appareil' (à simple rentrée d'air) 'de la colle de farine extrêmement légère, de l'albumine, de l'urine, de la bière, du foin, ou de la noix de galle, *constamment* on voit apparaître des microphytes ou des microzoaires après un temps fort court.' How is this contradiction to be reconciled? Is not the former experiment most likely to be correct?

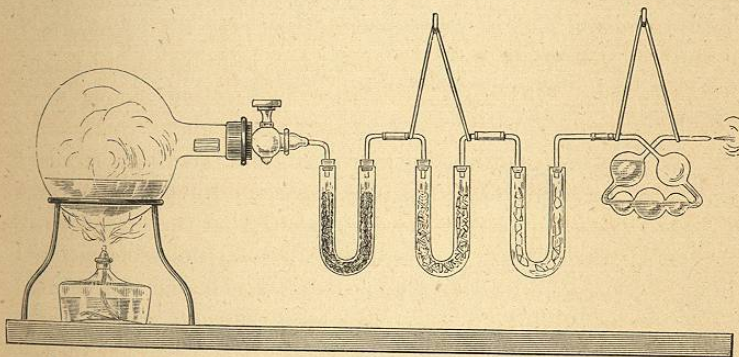


FIG. 63.—ANOTHER MODE OF REPEATING SCHULZE'S EXPERIMENT. (FROM POUCHET.)

He then goes on to describe an experiment 'much more 'rigorous' than that of M. Schulze.

'Dans un ballon dont le col placé horizontalement supporte un robinet, je mets une certaine quantité d'eau ordinaire. Un corps fermentescible renfermé dans un gros tube de verre, et qui a été préa-

¹ I previously pointed out that Schwann's experiment, which was occasionally unsuccessful in Pasteur's hands, was not that to which M. Pouchet alludes, but that performed over mercury; and Pasteur has abundantly demonstrated the fallacy here and how it can be overcome.

² See *Nouvelles Expériences sur la Génération spontanée*.

lablement chauffé à 150° C. pendant cinq heures, est placé à l'intérieur du col de ce ballon : ce tube est fermé par un opercule rôdé à l'émeri et scellé hermétiquement avec lui par une substance facilement soluble dans l'eau. Le ballon communique avec trois tubes en U et des boules de Liebig. L'un de ces tubes contient de la ponce sulfurique, un autre de la potasse caustique, et le troisième du coton cardé.

'Les boules de Liebig sont remplies d'acide sulfurique concentré.

'A l'aide d'une lampe on met l'eau du ballon en ébullition pendant dix minutes, et ce n'est qu'ensuite qu'on articule les tubes en U à l'extrémité du tube de Liebig. Enfin on éteint la lampe, et, tandis que l'appareil se refroidit, l'air extérieur y rentre en traversant l'acide sulfurique, le coton, la ponce sulfurique et la potasse. Quand l'appareil est parvenu à la température ambiante, on fait tomber le tube dans le liquide, et lorsque celui-ci a dissous la substance soluble qui lute l'opercule, ce dernier s'ouvre et l'eau envahit l'intérieur de ce tube.

'Peu de temps après, constamment on voit la liqueur du ballon se peupler de végétaux et d'animaux microscopiques, selon les substances que l'on a confinées dans le tube. Jamais en suivant ce procédé l'expérience ne manque.'

Such is the experiment which is more rigorous, certainly much more complicated than Schulze's. Nevertheless there are numerous loopholes in it.

Thus this little tube containing the fermentescible material is cold, and may be covered with dust when introduced into the neck of the flask. It is certainly strange that, in order to be certain that organisms should develop, it is necessary to heat the great bulk of the water used, and the putrescible material in a small quantity of water separately, and then to unite them in the manner described. For Pouchet himself admits that he does not always get organisms with Schwann's simpler method.

Then, again, it is no easy task to cork thoroughly a vessel heated to the boiling point of water; and the cork used was in no way purified. It is true that steam passed over it for a short time, but then steam is dry heat, and it is generally admitted that dry heat at the temperature of boiling water is not sufficient to destroy all organisms. This argument also applies to the dust on the wall of the vessels. And then in tilting the vessel to introduce the tube into the water, the joints, unless very securely fixed, may open, or living dust may be shaken into the

fluid from the neck or cork, leaving out of consideration the fact that it is in all probability carried in with the small tube.

Pouchet looks on this experiment as completely disproving those of Schulze, Schroeder and Dusch, and Pasteur, and why? Because with this apparatus he constantly obtains organisms. How then does he explain Pasteur's results? Pasteur boils his fluids for two or three minutes, and finds that they remain barren. This experiment can only be answered by Pouchet (so long as he adheres to this line of argument) by supposing that Pasteur is making a false statement, or that by boiling his fluid he has destroyed its power of producing organisms spontaneously. As regards the first, a committee composed of the first scientific men in France confirm the truth of what Pasteur asserts; while the second can have no force when looked at in the light of Pouchet's own experiments; for we find that the latter obtains organisms after keeping his fermentescible material at a temperature of 110° C. for several hours, and boiling the water for from 30 to 60 minutes.

Such a method of reasoning and of experimentation would not have deserved so much notice were it not for the great influence which Pouchet's work has exercised and does still exercise on those who have not read or studied it. And I have felt it the more necessary to consider his work in detail as he is one of the last observers who has maintained a more or less complete heterogenesis, and also as I am not aware of any work in which his experiments have been subjected to a searching criticism.¹

¹ Pouchet's experiments and conclusions were objected to by Milne-Edwards, Payen, Quatrefages, Claude Bernard and Dumas, who examined them, and also those of Pasteur.