Therefore, the conclusion seems justified that as test animals, the use of guinea pigs which have already received an injection of digitalis is unsafe until the length of time required for complete recovery can be definitely decided. It has been my own impression (unsupported by any experimental evidence) that even after a month has elapsed, unsatisfactory results may be secured, and it has been our invariable custom to use fresh animals in the final assay of any preparation.

If uniformly satisfactory results may be obtained after a month has elapsed, it is obvious that the second use of such animals as recovered will be nearly as costly as purchasing fresh pigs, because the food and care, added to loss from natural causes, will amount to a considerable sum.

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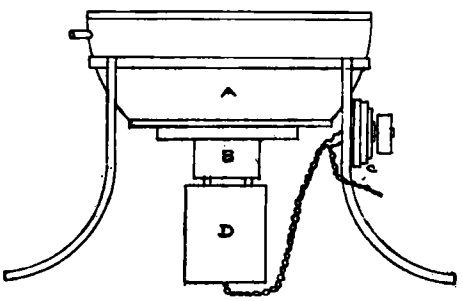
CONVENIENT ELECTRICAL WATER BATH.

JOHN W. FORBING, CREIGHTON UNIVERSITY.

An electrical steam bath filling the demand for convenience and safety, in laboratories lacking live steam and employing inflammable liquids, may be easily constructed: A 500 ampere General Electric heating unit, round and flat, is soldered into the bottom of the ordinary copper constant level water bath. The unit is connected with an attachment plug screwed into one of the legs of a tripod which may be used to support the bath. Cord and hubble attachment plug enables the user to move the bath to suit convenience. As used by the author on a 110 volt, 60 cycle alternating current, 475 watts are consumed. But three minutes are required to bring contents of bath to ebullition.



A, Water bath. D, Attachment plug.
B, Electric unit. C, Snap switch.

FORMATION AND DISTRIBUTION OF ODOROUS PRODUCTS IN PLANTS.*

PROFESSOR EUGENE CHARABOT, SC. D., PARIS, FRANCE.

Professor E. Charabot, Sc. D., of the Sorbonne of Paris, was presented to the large audience by Professor Samuel P. Sadtler, who in his introduction stated that the speaker by virtue of his numerous and monumental labors and contribu-

*Report of a lecture delivered before the Philadelphia College of Pharmacy, Oct. 17, 1913, and reported in English by Prof. I. V. S. Stanislaus.

tions to science, and especially his excellent work on Volatile Oils and odorous principles, is one of the world's recognized authorities.

Professor Charabot spoke in French. His eloquence held the audience for over an hour following his every word. In addressing his hearers he stated that he was proud to speak from the rostrum of America's oldest College of Pharmacy, and that he was well acquainted with the work of America's investigators of odorous bodies, to mention only Professors F. B. Powers, a graduate of this college, Edward Kremers, I. V. S. Stanislaus, Henry Kraemer, whose book on Botany is always on his desk, regretting not to have met Doctors Pancoast and Pearson, the other Philadelphians contributing to the chemistry of Volatile Oils. He wanted also to pay his deep respects to the chairman of the Pharmacopœial Committee, Professor Joseph P. Remington, and last but not least, to the Chairman of the evening, Professor Sadtler, whose many labors were well known to him.

Proceeding, Professor Charbot spoke as follows:

Among the innumerable substances elaborated in the plant organism, there are some whose physiological role is so manifestly predominant, that their study is right at the outset forced upon the attention of chemists and physiologists.

The mechanisms which govern the changes and migrations of the carbohydrates, the cooperation of these principles in the fundamental phenomena of plant life, are known in all their ramifications. And then, moreover, even though one is unacquainted with the chemical constitution of the albuminoid substances, their physiological role as well as their actions in the functions of life, have been very carefully studied, if not accurately determined.

But in addition to these bodies of foremost interest, the carbohydrates, albuminoids, and the fatty substances, there is a multitude of others whose role seems to be more in the background, but which, nevertheless, though their normal and constant presence prevents this from being suspected, should have a very well-defined significance, and perhaps even participate in an essential function. The odorous compounds are among these. Their appearance, their distribution, their evolution, their physiological role, deserve, for this reason, an impulse of scientific curiosity. This is the more so, as the perfume principles of plants adapt themselves in the most perfect way, (thanks to the precision of the methods of handling, which are suitable to them) to the study of plant chemistry in some of its relations to the action of animate matter. These considerations, of a purely philosophical order, should be in some measure sufficient to show that the question which I am going to have the honor of expounding deserves to take a place in the plan of our physiological knowledge.

Some other considerations and these are of an immediately practical kind, make of my subject a particularly interesting question. The cultivation of plants for perfume, supplies one of the most important of French industries; an industry which finds the most extraordinarily favorable conditions for plant vitality on that beautiful and smiling coast, known throughout the world under the name of "de Cote d' Azure"—(The Azure Coast).

So the subject whose concise explanation you have been pleased to honor me in asking me to present, appears to us of interest, both speculative, and at the same time, practical.

The study of the mechanisms which regulate the formation of the odorous matters and their evolution, the investigation of the relations existing between the chemical phenomena which modify these substances and the immediate manifestations of the life of the plant, the knowledge of the part played by the essential oils in the vital economy, constitute so many enticing problems which, it will be readily conceived, have a capital importance, not only from the point of view of rational cultivation and of judicious harvesting, but also from the point of view of the rational extraction of the perfume of the plant.

To this study I have devoted, either alone or in collaboration, principally with Mr. Al. Hebert, more than ten years of research work.

The question embraces: the formation and circulation of the odorous compounds; their evolution and the mechanism of this evolution; the genesis of the odorous matters and the physiological role of the perfumes.

Formation and Circulation of the Odorous Compounds.—The odoriferous plants form two very distinct groups as regards the distribution of their aromatic principles among the various organs. In some the essential oil makes its appearance in the green organs; in the others it exists exclusively in the flowers. Thus it will be necessary to consider separately the perfume in the entire plant and the perfume in the isolated flower.

The Perfume in the Entire Plant.—We have experimented with various representatives of the vegetable kingdom, belonging to different families and containing the most diversified chemical substances, and we have arrived at the following conclusions:

The odorous kinds of matter make their appearance in the young, green organs. They continue to form and accumulate until the following period, but with an activity which slackens more or less appreciably. They migrate from the leaf into the stem, and thence into the inflorescence, obeying the laws of diffusion: a portion enters into solution and, by osmosis, penetrates into the stem. On arriving in a medium already saturated with similar products, a portion is precipitated, whilst the rest, consisting of a relatively soluble mixture, continues to diffuse through the membranes and reaches the organs of consumption particularly the inflorescences.

At the time when the work of fertilization is accomplished, a certain quantity of essential oil is consumed in the inflorescence. It is possible and even probable that the green organs produce at the same time further quantities of odorous matters; experiment only permits of the determination of the fact that the difference between the production and consumption is expressed by a loss at the period when the functions of the flower are accomplished.

The practical consequence of this last conclusion is that the harvesting of the perfume-yielding plants should be effected shortly before this consumption takes place, that is, before the act of fertilization.

When this act has been accomplished, the odorous principles appear to descend again into the stem and, generally, into the organs other than the flower, a migration which is probably induced by the desiccation of the inflorescences, which involves, other things being equal, an increase in the osmotic pressure and a partial precipitation in situ of the least soluble principles.

The Perfume in the Isolated Flower.—There exist, as was supposed by J. Passy and as was proved by A. Hesse and his collaborators, two categories of plants: one class, continuing to produce odorous matters when placed under conditions such that the vital functions may still be exercised; the other class, containing the whole of their odorous principles in the free state and incapable henceforth of producing any further quantity, even though their vitality be not arrested.

Evolution of the Odorous Compounds and Its Mechanism.—These researches, which I have carried out partly in collaboration with Mr. A. Hebert, have led to the following conclusions: The compound ethers (esters) have their origin, in particularly active fashion, in the green portion of the plants, by the direct action of the acids on the alcohols previously formed. This phenomenon of esterification is assisted by a special agent playing the part of a dehydrating agent, probably an enzyme of reversible activity.

The influences which are capable of modifying the plants so as to adapt them for a more intense chlorophyllian function are favorable at the same time to esterification, because this function is favorable to the mechanical elimination of water.

Thus the chlorophyllian function tends to acquire a new significance: It not only assures the fixation by the plant tissues of carbonic acid gas, it not only effects, by favoring transpiration, the circulation of the liquids which carry and distribute the principles necessary to the mineral nutrition of the plant, but it also activates, once the carbon is assimilated, the condensations which enable the passage from a simple chemical structure to one of the innumerable complex structures, the study of which taxes all the ingenuity of the chemists.

When the alcohol is capable of readily parting with the elements of water, it gives rise, together with the compound ethers (esters) to the corresponding hydrocarbon, so that the first transformation which the alcohols undergo are due to phenomena of dehydration.

The phenomena of isomerisation, that is, changes of nature without change of composition, also proceed together with the matamorphosis of the odorous matter. Lastly the alcohols and their ethers are actively converted into their oxidation derivatives, particularly when the inflorescences appear, in which organs the fixation of oxygen by the tissues is particularly intense.

Genesis of the Odorous Matters.—The sum of my researches, and the interesting observations of M. Hesse lead to a conception of the genesis of the odorous matters in the plant. A large number of the odorous products, very diverse in their functions and chemical structure, are produced in consequence of the splitting up, with fixation of the elements of water, of principles called glucosides. It is sufficient to admit the general nature of such a mechanism to arrive at a satisfactory explanation of the facts observed with regard to the formation of the odorous matters and their appearance at any particular point of the vegetable organism.

It seems to me that there is reason to believe that the glucoside which is capable of yielding the essential oil is formed or tends to be formed in the green portions. Most frequently, this glucoside immediately encounters the conditions of environment which are favorable to its decomposition, and then the essential oil appears in the green portions and begins to circulate, evolve itself and play its part. It may even happen that the medium is so favorable to the splitting up of the gluco-

side, that the latter can never be formed; in this case the whole of the essential oil will exist in the free state in the green organs.

In other cases, the glucoside only comes in contact with the ferment which is capable of splitting it, in the flower. It will then only be after it has circulated as far as the flower, undergoing in its course more or less profound modifications, that it will be able to liberate the constituents of the essential oil, and the flower alone will be odorous. It is not impossible that, in certain flowers, the medium may be so favorable to the splitting up of the glucoside, that the latter is completely split up as soon as it arrives there. The formation of further quantities of essential oil in certain flowers in proportion as the essential oil already formed is removed, would be explained by a phenomenon of chemical equilibrium. The following reaction:

$$\text{Glucoside} + \text{Water} = \text{Glucose} + \text{Essential Oil}$$

would be restricted by the reverse reaction, and a state of equilibrium would be reached when the glucose and the essential oil would amount to a certain proportion. Thus the flowers in question, if left to themselves, would retain a quantity of perfume which would not increase. On the other hand, if the essential oil be removed as fast as it is formed, the decomposition of the glucoside would no longer be limited, and it would continue to take place. Consequently, the appearance of a fresh quantity of perfume in the plant whose life is prolonged whilst the odorous matter is continuously removed, follows as the result of a phenomenon of chemical equilibrium in the vegetable cell. The type reactions will serve as an explanation of the changes:

$R.OH > R.CHO > R.COOH. + (H_2O)n.$

$R.OH + R.COOH > R.COOR. + (H_2O)n.$

$R.CHOH > R.CO.R + (H_2O)n$—accounting for the formation of alcohols and phenols, and their aldehyds, acids, esters and ketones, etc.

It will be understood, without it being necessary to insist on it, what advantage we have been able to derive from the practical standpoint as regards the value and the yield of perfume, from all these results obtained by scientific research.

Physiological Role of the Odorous Matter.—In collaboration with Mr. Hebert, I have proved that, contrary to what was previously believed, the odorous kinds of matter are not waste products of which the plant cannot make use. They are capable of being utilized by the plant, particularly when the latter is protected from light and no longer assimilates the carbonic acid of the air with the same intensity. They participate normally in the work of fertilization and of the formation of the seeds, in the course of which they are partially consumed."

At the conclusion of the lecture Professor Sadtler announced that Professor Stanislaus had kindly consented to render the lecture into English for the benefit of the American public.

The entire audience including Professors Lowe, Sadtler, Kraemer, Mr. Otto Kraus an others were loud in their praises of the excellence of the lecture.