MICHEL GONNET GABRIEL VACHE

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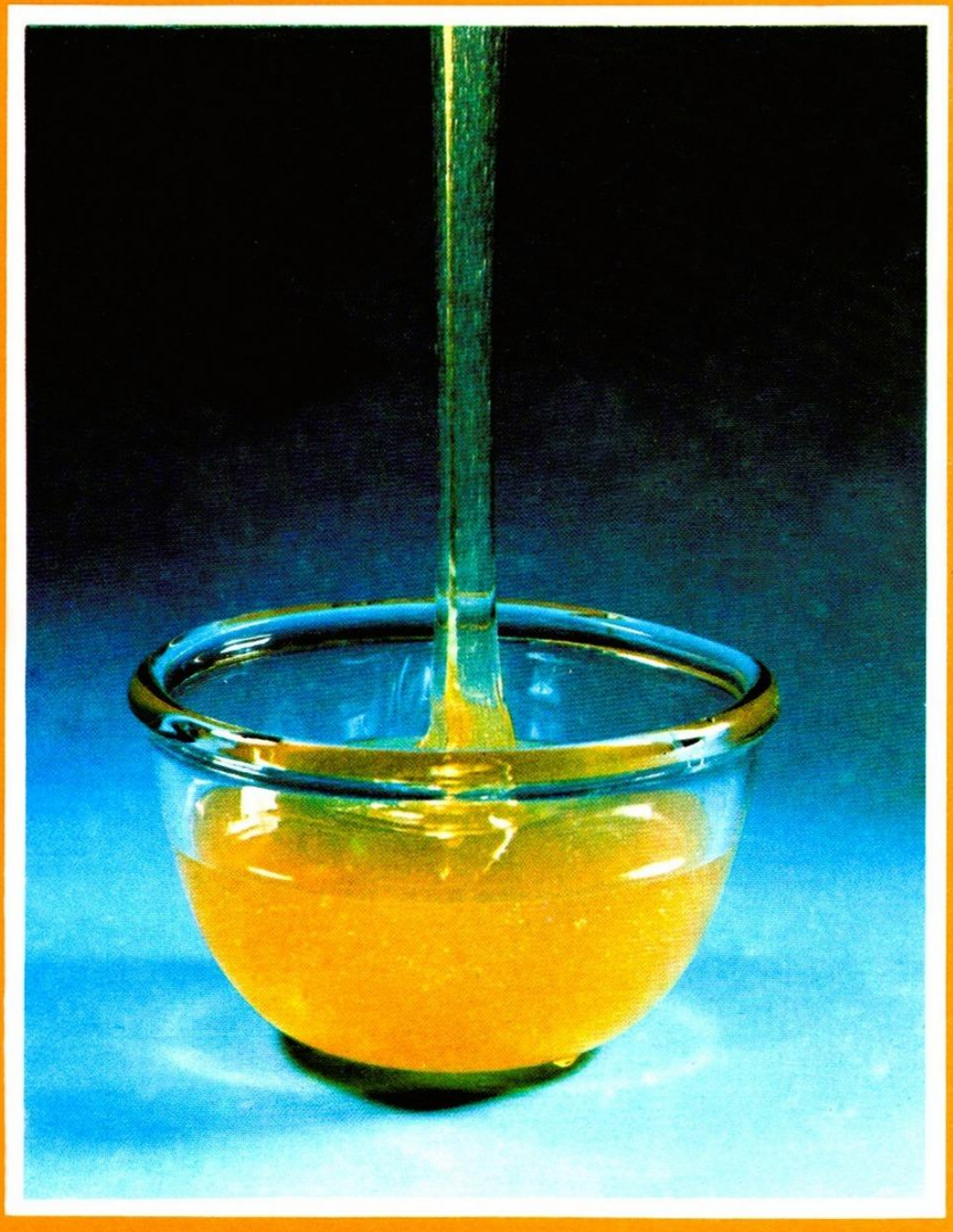

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THE TASTE OF HONEY

The Sensorial Analysis and Different Applications of an Evaluation Method of the Quality of Honeys

Preface by P. Jean-Prost

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"The best, the most appreciated honey is sweet, penetrating and delicately perfumed, of a pale yellowish colour. It is not liquid but coagulated, thickening afterwards. It does not flow and sticks perfectly to the finger when one touches it. Spring honey is the best and so is summer honey. Winter honey remains very thick, it is a lot less pleasant".

Dioscoride 25 A. D. (— in Honey — Eva Crane).

Sacred honey, the symbolic honey of the ritual offering, honey all sweetness and love, honey sovereign remedy: the mythological references are numerous and diverse, all of then consecrate a precious product of a divine essence. But it does not preclude the pleasure of taste and its sensorial description made by Dioscoride, a celebrated Greek physician, at the same time undoubtedly a fine taster, that is not devoid of interest. It certainly demonstrated that during that legendary epoch "the taste of honey" had been appreciated as well.

"God's word is sweeter than honey flowing on honeycombs", Ps. CXIX.

"Eat honey, son, because it is good,
A honeycomb is sweet for your palate
Know that wisdom is the same for your soul!"

Solomon "The Song of Songs"
XXIV; 13, 14

"The tip of my tongue is covered with honey and an even sweeter one covers its root.

You submit to my desire and will and you will be mine, wholly mine.

My arrival has the taste of honey and sweet as honey is my departure too.

My voice and words are sweet and I desire you would regard me as honey.

I weaved a sweetened veil around you to banish hatred.

To be loved by you, my love, forever".

Love poem from "Rig Veda", the oldest of the saint books of India, written 2,000 — 3,000 years B.C. This "sensorial message" of honey is a symbolic reference to gentleness and love.

Here are a few *proverbs* and *popular sayings* related to honey, symbol of sweetness (in a proper and figurative sense) of happiness, of "luck", of celestial protection. Metaphors often use the contrast between honey and sting, between sweetness and venom, between good and evil, between virtue and vice.

"Who does not have honey in the pot should have it in the mouth"
"Expensive is the honey licked from thorns"
"Who harvests honey and the rose should bear stings and thorns"
"If you like honey do not be afraid of the sting"
"Who is afraid of the sting never earns the honey"
"Bees have honey in their mouth but a sting in their tail"
"There is no honey without bees; There is no money without work"
"If you wish to harvest your honey, do not overthrow the hive"
"Where there are bees, there is honey too"
"Wherefrom the bee forages honey, the spider forages venom"
"Killing poisons are hidden under the sweetness of honey"
"Honey mouth, tongue of gall"
(In a proper sense this proverb does not fit the taster)
"Just a little gall spoils good honey"
"A drop of honey draws more flies than a cask of vinegar"
"Bees forage honey and honey catches bees"
"Where there is honey bears come flocking"
"Cover yourself with honey and flies will eat you"
"A lazy man never feeds on honey"
"Eat your honey and say nothing"
"Bees make honey and man eats it"
"He who likes honey often licks his fingers"
(Not when he is a taster!)

SUMMARY

Preface

The improvement of beehive products, one of the objectives of beekeeping research in France, regards all the stages in a beekeeper's work.

Interventions in the beehive, the migratory beekeeping circuit, the time and way of harvesting, maturation, packing, storing, all of them have their consequences upon the quality of the main beekeeping product, honey.

In fact, what needs to be understood is not quality in itself, but the characteristics that give to honey its qualities derived from flowers, from bees and from the beekeeper's care. Honey doesn't exist by itself: every foraged flower transmits its nuance, taste, perfume to the huge range of honeys, upon which the beekeeper puts his own stamp through his bees and care.

Every keeper of bees, amateur or professional, knows how to inspect a colony, to divide it, to get it to the right place and whenever it is necessary, to harvest honey and to put it into pots. But how many of us know how to evaluate honey. I do not mean by this to find it good, very good or mediocre but to distinguish, to define, to evaluate, to calculate every single feature out of the numerous parts of its quality.

We can be excused for this ignorance: because up to now no French or foreign publication insisted on the sensorial evaluation of honeys.

But now, this gap is covered by bringing together, on the one hand, knowledge of wine evaluation as it is practiced at numerous and at the same time serious tasting meetings and, on the other hand, knowledge about the constituents of honey and their evolution in time.

This blend is the result of the meeting of two field people with extensive and solid information.

Gabriel VACHE, divisionary engineer in the field of agricultural works, leads a center of agricultural vocational training and promotion. For many years he has organized and stimulated the organization of courses in tasting.

Michel GONNET, engineer at the Zoological and Apidological Station of the National Institute for Agronomical Research in Mont-

favet (Vaucluse) dedicated the largest part of his life to the study of honey, its composition, properties and evolution; as well as to factors that by the way of changing its constituents lead to a change in its qualities.

This happy reunion, at the Beekeeping School in Hyères of a perfect wine expert and an expert in honeys offers us the pleasure of having a missing tool:

— beekeepers who would like to offer better honey;

— consumers who appreciate bee products;

— members of the honey evaluation jury at the General Agricultural Competition in Paris or at numerous fairs — regional exhibitions that point out the value of our beekeeping products all over France.

Michel GONNET, Gabriel VACHE, my friends, you laid a new stone at the edifice of science and art, at that of everyday life required by further progress.

All beekeepers, irrespective of their status in honey problems, all occasional or permanent fine connoisseurs and all tasters extend their thanks to you.

Pierre JEAN-PROST

Foreword and Previous Works

The first course in beekeeping training with the main theme "The sensorial analysis of honeys" was organised in Hyeres (France) in the autumn 1978. The Experimental Beekeeping Station of the National Institute for French Agronomical Research in Avignon, as well as the Center for Vocational Training and Agricultural Promotion in Hyeres ensured the preparation and stimulated the organization of this course. The subject was new and we possessed few original references gathered from beekeeping. We asked our oenologue colleagues for support and they contributed with their experience. Viti-vinicultural circles have been interested in the sensorial analysis for a long time. They have developed a genuine art of tasting with its ritual, but of course they were especially concerned with its technique, discipline and earnestness. In fact this practice of sensorial evaluation tends to spread to all agricultural and food spheres. Therefore, we used all these previous works to prepare our course (there is a list of the consulted books at the end of this memorandum).

Since then this course is resumed every year at CFPPA in Hyeres, in the framework of vocational training. This pedagogical session involves an important number of experimental practical works. It deals especially with the tasting tests that we adapted and developed. The analysis of the answers given by the participants proved to be also rich in teachings. Finally, in the framework of these courses we proposed a general technique conductive to a better evaluation of honey quality according to visual, olfactory, gustatory and tactile criteria. More experimental courses of the same type were conducted by one of us in different vocational centers in France, as well as in Italy.

The technique of evaluation and classification of honeys developed by us is based on the products' intrinsic qualities and deficiencies. It has been adopted at a lot of big competitions organized in France and Italy on the occasion of agricultural fairs of regional and even national importance.

A certain number of subjects will be tackled in this work: we will especially strive for a definition of the basis and limits of the sensorial analysis, the limits it has underlining its importance in the analysis of honeys, to present the applied tests and the first results; this way of approaching the problem of deficient honeys and, finally, seeking the possibility to objectively classify honeys at competitions, but also to grant labels that are a guarantee for their quality. Finally,

it was deemed important to help the readers and the future tasters to better get acquainted with the bees' product. In Chapter I will be found a summing up of the composition and essential properties of honeys. In brief, we tried to gather every bit of information indispensable to whoever would like to become a competent taster.

Scientific works on the sensorial analysis of honeys are rare. The booklet published in this field by P. J. GONNET in 1951 is a collection of basic information in taste chemistry and physiology, containing however a schedule of a sensorial vocabulary applicable to different types of honey. There is no concrete data on the practice of tasting in this interesting, but rather philosophycal work. In a remarkable work on "The Technical Vocabulary of Organoleptical Characters and Tasting of Food Products" Le MAGNEN (1961) suggests nine terms liable to characterize normal or deficient honeys (aroma, with smell of cabbage, clear, hot, fermented, dark, hard, smoked, tinted). It is a first but very insufficient approach in this field. MAURIZIO (1975) suggests that honey should be tasted according to its dilution in water. It is the author's opinion that this practice allows a better dissociation in the mouth of the sweet flavour from other different components of taste. But neither here has a scale of reference been established; there is no draft grid that could allow a translation of the perceived sensorial stimuli. Moreover, if honey dilution can help smell perception, it will sensibly modify the evaluation of aroma. American authors (MILUM 1955) studied the flavour of honey taking saccharose as a unit of reference. They analyzed "the sweetening power" of the main sugars contained in the bee product. In this sense we should note that saccharose in a certain type of honey is an important factor, but very sporadic at the level of global sensorial evaluation. Different research has been undertaken to detect and analyse the volatile aromatic elements present in honeys: an American researcher (MAGA 1983) has done a compilation on this subject. It is very difficult to establish a precise relationship between the sensorial quality of honeys and the very numerous volatile compounds contained in these products. Finally, we have to note the works created under the aegis of the Technical Beekeeping Institute of France, as well as those conducted by a group of Italian researchers. There are two collections out of which we present excerpts in the annex to this work. The authors have compiled an ensemble of precise analytical features aimed at evaluating different monofloral types of honey. There are a few references to the physical state, colour, smell and taste in the chapter "Descriptive and organoleptical features" of this work. However, with the exception of colour which is measured, the other sensorial features are just the object of a rapid and much too brief description.

Therefore, it can be said that nothing basic and concrete has been achieved in the field of the sensorial analysis of honeys. Undoubtedly, at present, this work is the most complete and important

one that has been achieved in this domain. Its main objective is to make honey better known and appreciated, starting with taste. This is a very technical approach to this problem, an authentic apprenticeship in search for quality, that normally should lead the beekeeper reader to a concrete approach in best conditions of studying the technology that would enable him to better harvest, better prepare and better present his products. To succeed in the promotion of honey as food, to stimulate its increasing consumption, to determine the formation of an expert body of tasters entrusted with judging its quality — these are the main targets of this work.

I. Honey

A) The Origin, Composition, Natural Modifications of the Structure and Essential Properties of Honeys

a) Origin

Honey is produced by bees from saccharose produced by vegetation. There are mainly two types of sweet production exploited by bees: *nectar* and *honeydew*.

NECTAR is an exudation of the glandular excrescencies (nectaries) of certain types of vegetation. Very often nectaries are placed in the flower toward the corolla basis. Fine sweet drops that trickle like small grains, attract bees that forage them, they mix them with salivary secretions and bring them to the hive. This saccharose nectar will become honey after transformation and concentration.

HONEYDEW is made by an intermediary guest (in general by leaf lice) that pierce the soft parts of vegetation, feed on the nitrogenous matter contained in the sap and leave aside saccharose that cannot be digested. This exudation that remains as sticky plaques on vegetation are sometimes taken back and transformed by the bee. The product made in this way is honeydew honey. Therefore, honeys that are produced from nectar or honeys made from honeydew are very complex products, especially the latter. This relative complexity is linked to *their double origin: plants* but also the soil that serves as a support; *insects* that forage and elaborate the product with the help of the secretions with which they mix it. Certain substances are always present in honeys; it is the case of water, saccharose and organic acids. Honeys mainly contain carbohydrates in the form of different sugars. These represent between 96 to 99% of the dry matter present in the product. But the percentage of these different sugars among them vary from one type of honey to another; moreover, the presence of some of them is not constant. What is true for saccharose is true for the other constituents as well. The reader will find in Table I a classified list of honey composition. It is not exhaustive, although all constituents that appear on this table will not be systematically found in all honeys (we pointed out those that undergo quantitative variations but whose presence is constant).

b) Main Constituents

1. Water

The average water content in most honeys is between 17—18%. In spite of this the possible amplitude ranges from 14 to 25%.

Water content in honey is an essential analytical data that the beekeeper is most interested in knowing and, if possible, mastering. Only honeys with less than 18% moisture keep well. By applying an adequate technology one can sensibly lower the water content of a too watery honey without provoking essential changes in the product.

Honey is a reactive medium, it evolves, changes and depreciates according to its water content.

2. Glucosides

These are mainly sugars that account for the essential dry matter of honey:

We distinguish:

— *Reductive monosaccharides* also named hexoze (6 atoms of carbon). They are *glucose* (dextrose) and *fructose* (levulose). These two sugars represent an average of 90% of the total sugar content of honey. The proportion of each of them varies according to the origin of the product; as a general rule, fructose is the most abundant monosaccharide in honey.

— *Di, tri,* and *polysaccharides,* reductive and nonreductive. The main and most constant of them is *maltose.* But also residual saccharose can be found (the dominant sugar in nectaries), it is hydrolized by bees while producing *melesitose, erlose* etc.

3. Organic acids

All honeys have an acid reaction. They contain free organic acids or combined as lactides. *Gluconic acid* is by far the most abundent in honey (between 70%—80% out of the totally free acids). It is formed out of glucose and this phenomenon is accompanied by a release of oxygenated water (H_2O_2). Qualitatively, other fixed acids undoubtedly of vegetal origin, were revealed in honey, for instance the citric, malic, succinic, oxalic acids... Honey contains a few volatile acids. Formic acid, for quite a lot of time considered as dominant in honey, in fact accounts for less than 10% out of the totally free acids.

Conventionally honey acidity is expressed in miliequivalents per kilogram. It oscillates between 10 to 60 mecv./kg according to origins

AVERAGE COMPOSITION OF HONEYS

Main constituents

(15 to 20%) *water* (75 to 80%) *carbohydrates* (1—5%) *different substances*

Carbohydrates (Saccharose)	*Acids* (0.1 to 0.5%)	*Proteins and Aminated acids (0.2 to 2%)*	Vitamins	*Enzymes* (diastases)	*Minerals* (0.1 to 1.5%)	Other components
Reductive monosaccharides	*Gluconic acid* (free or combined)	*Albuminoid matter*	*Traces of:*	*Amilase* (and)	*Potassium*	*Aroma*
70 to 75% glucose	70—80% of total	*Nitrous matter*	Thyamine	*Invertase* (glucoinvertase)	*Calcium*	Methylantranilate
fructose	acidity	*Traces of proline*	Riboflavine	*Glucose-invertase*	*Sodium*	Formaldehide
Disaccharides	Malic acid	Tripsine	Piridoxine	*Traces of:*	*Magnesium*	Acetylcholine
Maltose	Succinic acid	Leucine	Biotine	Catalase	*Manganese*	Alcohols
Isomaltose	Oxalic acid	Histidine	*Ascorbic acid*	Phosphatase	*Iron*	. . . . .
Sucrose	Glutamic acid	Glicine	Pantotenic ac.	Oxidating	*Copper*	*Pigments*
Tri- and poly-saccharides	Piroglumatic acid	Methionine	Nicotinic ac.	Enzymes	Cobalt	. . . . .
Erlose	Citric acid	Aspartic acid	Folic ac.	. . . . .	Boron	*Flavonoids*
Raffinose	Glucuronic acid	. . . . .	. . . . .		Phosphor	*Fat acids*
Kojibiose	. . . . .				Silicon	. . . . .
Dextrantriose	*Formic acid* (10% of total acidity)				Chromium	*Antibiotical factors*
Melibiose	Butiric acid				Nickel	. . . . .
. . . . .	Capric acid				Barium	*Hydroxymethyl-furfural*
	Caproic acid				Cessium	*Figurative elements*
	Valeric acid				Gold	
					Silver	
					. . . . .	

4. Proteids

Honey scarcely contains proteids (0.1 to 0.25% out of fresh weight). These proteids are in general proteins, as well as free aminated acids of animal or vegetal origin. One of these aminated acids is present in considerable quantities in all honeys; it is *proline.*

The content of *nitrogenous matter* in honey is sometimes abnormally high. It is often the case with honeys extracted under pressure out of wax cakes because frequently during the operation brood and pollen are also crushed. These traditional products increasingly scarce otherwise preserve very badly. This percentage can be relatively important and it is quite natural; when honey comes from heath it contains between 1 and 2% vegetal proteins.

5. Mineral substances

Honeys always have a low content of mineral matter, although their proportion vary widely from one product to another (from 0.05% to 1.5%). Floral honeys contain an average of 0.10% to 0.20% mineral substances while in honeydew honeys this is approximately 1%. In all cases *potassium* is the dominant element. From the qualitative point of view a large number of minerals can be found in honey.

Honey could serve as an index for the detection of certain mineral pollution. The investigation of the main mineral constituents and their average proportion serve as basis for these studies.

6. Enzymes

Honey enzymes come from bees' sallivary glands and pharynx secretions. Mainly, they are:

— *amilase* (α and β) that causes a degradation of amides and dextrines especially in maltose.

— *a gluco-invertase* (α glucosidase) that causes the turning of nectaries saccharose into glucose and fructose.

— *a gluco-oxidase* out of which gluconic acid is formed in honey. This enzyme provokes the glucose hydrolysis that is accompanied by a release of oxygenated water.

Also revealed in honey were traces of *catalase*, as well as different *acide phosphatases.*

7. Vitamins

Vitamins scarcely pass from plant to nectar or honeydew. Therefore honey is a natural food with an insignificant vitamin content in general. Yet there are some traces of vitamins of the B and C group and sometimes A, D and K. Some honeys are however richer in vitamins than the others. So that the average content of vitamin C in a certain type of honey (the most constant and abundant vitamin in ho-

ney) is about 2 mg/100 g fresh product. Certain honeys as, for instance, that of thyme may contain more than 50 mg. (We specify for comparison that a lemon contains an average of 100 mg vitamin C).

8. Aromas

The aromatic substances are of an outstanding interest. The study of honey aromas has not yet been exhaustively undertaken. Yet a few recent works bring information and new points of view in this field. Approximately a hundred different volatile derivatives were identified or recognized in various kinds of honey. In exchange, very few things are known in connection with the combinations of volatile substances that borrow the aromatic specificity to certain honeys. The little information we possess in this regard will not be very helpful in the field of sensorial analysis. For instance, it is known that *methylantranilate* is a precursor of the specific citrics aroma; some traces of this substance are to be found in lavender honey as well. Formaldehide and acetaldehide are mainly found in rape and alfalfa honeys that could be explained by a certain aromatic "kinship" between these two honeys. Other volatile compounds have been identified in a few different honeys as for instance: izoamylformate and acetate, phenylethylacetate, ethyl and methyl formate and palmitate, propionaldehide, benzaldehide, methylbutanole etc... In a large number of honeys we find traces of different alcohols (ethanole, izobutanole, methylbutanole, propanole, pentanole...), as well as other unidentified esters.

9. Colour

The colour of honeys is due to pigmentary matter, as *carotene* and *xantophyle.* It undoubtedly originates in *polyphenols* of a *flavonoid* type.

The phenomenon of melanism in saccharose during the ageing or heating processes induces an intensification in the colour of honeys.

10. Lipids

They are practically nonexistent in honey. However, traces of triglyceride, fat acids of the palmic acid type for instance were identified.

11. Antibiotical factors

Honey is a strong bacteriostatic medium. This antibiotical activity is emphasized by a test called "inhibine". It seems that this property is closely linked to the above-mentioned glucose-oxidase activity. The phenomenon becomes apparent due to a hydrogen peroxide

release that accompanies the formation of gluconic acid in honey. In this case it has a pure antiseptical activity.

Yet the presence of *flavonoids* (of vegetal origin) in honey is condusive to the hypothesis that this product also has another real and original antibacterian activity.

12. Hydroximethylfurfural (H.M.F.)

Hydroximethylfurfural is a molecular dehydration derivative of monosaccharose and especially of fructose. It is a degradation. Therefore H.M.F. is not a normal constituent of honey; yet we find this substance in greater or smaller quantities in almost all samples. It is slowly formed during the natural ageing process of the product, and is accelerated by heating. H.M.F. presence in a certain honey emphasizes a quality loss. The legislator imposes declassification of honeys that contain more than 40 mg H.M.F. per kilogram.

13. Figurative elements

They are elements to be found in a state of suspension in honey. These are especially present in already filtered honeys as microscopical particles: pollen grains, yeast, spores... The content in figurative constituents is very poor except in the case when the product is badly filtered or honey is obtained by pressure.

Pollens especially help to determine honeys from the botanical and geographical points of view; their partial or total elimination is forbidden by law within the European Community.

c) Natural Modifications of Structure

Honey produced by bees and stocked at hive temperature *is in a liquid state.* After *a few days, a few weeks* or *some months* of conservation at normal temperature *the product crystallizes.* This process is perfectly natural for most honeys. The very strong saccharose concentration and especially glucose supersaturation of the medium, are generating this phenomenon. As a general rule, the liquid state is a phase of physical instability for honey; this tends to equilibrate through solidification. Crystallization appears more or less quickly, depending on the supersaturation degree that is globally defined by the glucose/water ratio. Other determining factors are especially fructose content, quantity of natural caps (primary crystals) contained in honey and surrounding temperature.

Honey crystallization is a very complex physical phenomenon. Crystals are formed and multiply in a supersaturated medium taking after the image of primary crystals or those introduced that serve as starter strips. Crystalline structure is the final structure; it is established when all crystals are linked among them. There are crammed,

compact structures formed out of very fine crystals; in principle, they correspond to rapid crystallization. There are rough, large, badly constructed structures, formed out of agglomerated crystals; in principle, they correspond to a very slow crystallization. We obviously meet all intermediary structures among those two extremes. The optimum temperature for honey crystallization is situated around 14°C. The multiplication speed of crystals is slowed down above this temperature level. It is stopped starting with 30°C. This phenomenon is identical for temperature lower than 14°C; below that, crystallization is blocked.

A few honeys are an exception to the rule and *never crystallize.* There are different reasons for the origin of this phenomenon, here are four of them:

— glucose that entered the product composition is found in a normal solution and is not supersaturated. It is the case with the honey of the *Robinia pseudoacacia* type (falsely named "acacia honey") when it is perfectly monofloral.

— the natural crystallization starter strips were entirely eliminated or destroyed. Or, even the strongly supersaturated solutions do never crystallize without inductors;

— honey is lacking a great deal of water, its viscosity is very high at normal temperature hence any natural mass multiplication of crystals is hampered;

— finally, honey contains an inhibitor of crystallization, a very rare case; the isobutiric acid can play this role.

Heating unbinds the crystalline structure of a honey liquifying it. This phenomenon starts around 30°C. To get a perfect and total remelted honey, we have to raise the temperature to 70 — 80°C.

We can very rapidly determine a perfect crystallization of a glucose supersaturated liquid honey. It is sufficient to seed it with natural crystals taken from another already crystallized honey and leave the mixture for 5 or 6 days at a lower temperature.

d) The Recognized Essential Honey Properties in Food, Diet and Therapeutic Fields

1. Nutritional and dietetical value

Honey is still used very often as an old traditional remedy. Yet *first of all it is food;* even this essential quality is not always acknowledged and its real value emphasized.

Honey is *glucoside food* with a very high caloric power (320 calories emitted for 100 gr ingested honey). It is formed out of a couple of simple saccharose (hexose):

— *glucose,* a great energy generator, directly assimilated by the

organism, leaves no waste;

— *fructose* assimilated after a slight transformation, it extends and intensifies the energetic action due to glucose; it has in addition slightly laxative properties.

In sensorial data, the *sweetening power* of honey (intensity of sweet flavour) is very high. If we have a reference value of 100 guss attributed to *sucrose,* glucose possesses a sweetening power of 74 (sensibly inferior to normal sugar) but *fructose* has a sweetening power of 173 (more than one and a half times sweeter than sucrose). Most honeys are richer in fructose than in glucose, but also contain between 15 to 20% water. Consequently, their sweetening power is on an average sensibly equal or slightly higher than that of dehydrated sugar.

Honey is a recommended food for short or longer physical effort. Sportsmen's food rations very often contain honey. The joke made by the celebrated beekeeper from New Zealand, Sir Edmond HILARY is well known. He conquered Everest because he had taken with him a few honey rations produced by his bees. After this confession made at his triumphal return to his country, honey consumption in New Zealand registered a rapid growth.

Honey used as glucoside support in baby food produced excellent results. Small children whose feeding bottles have been sweetened with honey develop more harmoniously and present less digestive disturbances than those fed with normal sugar. In the food ratio of elderly people, saccharose was also replaced by honey with the best statistical results, particularly in the metabolism of the intestine.

The mineral elements contained in honeys are very well fixed in and used by the body, particularly calcium. This was demonstrated by tests made in clinics.

With patients suffering from light forms of diabetes, some honey in their diet (honey very rich in fructose, preferably acacia honey) would be better tolerated than normal sugar. But we should be very cautious and act strictly under medical supervision. Experience in the field is controversial enough.

It is necessary to specify that honey is a very unbalanced food: proteids and lipids are lacking; it contains vitamins in small amounts. Nevertheless, by association with milk and fruit juices it can serve as basis for a complete diet. This test has been made by a contemporary doctor and it proved successful. This practice of food hygiene is otherwise mentioned in The Old Testament as a prophecy. The Promised Land was "that wonderful land where milk and honey abundantly flow". It saved Moses' famished followers after their being in the desert for a long time.

2. Therapeutical value

The therapeutical strength of honey is considerably mythical.

In antiquity, the bee's product, a true offering of the gods, was endowed with thousands of virtues. The ancient pharmacopeia incorporated honey in numerous preparations with medical destination. It was mixed with essential oils, with wine, with ash of a burned mouse (already something somewhat unexpected), with swallow and pigeon droppings or with cow dung. Every specific "preparation" was meant to cure most different diseases, as stomach congestion, jaundice, gout, carbuncle, varix etc... All these prescriptions can be found in the very serious "Historia Naturalis", a genuine bible of ancient medicine, written by PLINY THE OLD (23—79 A.D.). In the second part of this chapter the reader will find a few references to the multiple use of honey in antiquity. Contemporary physicians do not generally use honey as medicine, but traditions last and the emulators of "honey medicine" are still numerous. However, we have to specify that the serious scientific literature that deals with this subject is insignificant. It is frequently asserted, but without proof, that the therapeutical value of certain plant decoctions would result from honey contained in their nectar. Such assertions are totally unfounded and have no scientific basis. What is known about vegetal secretions and especially about substances that diffuse from plant to nectar do not confirm this hypothesis. Yet let us examine what has been demonstrated in this very controversial field that deals with the therapeutical value of the bee's main product.

Honey contains *antibacterial substances* (inhibine). This bacteriostatic property (inhibition of bacterian development, but not bacteries'destruction as well) is mainly linked to the above-mentioned release of oxygenated water.

The beneficial action of honey has been stressed in the clinical field, followed by the healing in certain cases of benign stomach, intestines, kidneys diseases, even common infections of the respiratory tract. Honey would also have a febrifuge action. We have to remain careful but it could be demonstrated that saccharose in honey, especially fructose, has a favourably calming action at the level of the irritated mucous of the stomach, intestine or superior respiratory tract.

The external use of honey as an antiseptic on sores and skin infections was widely spread in antiquity. Some contemporary clinicians successfully used bandages with honey.

To be clear, medicine using honey is no panacea. In this respect contemporary and popular medicine is full of false experiences, preconceived ideas, hasty or premature interpretations, erroneous observations, abusive extrapolations of scientific results. Honey introduced into the sickman's diet is good for him, but even if it intensifies the action of a medicine, it cannot replace it in any case.

B) Consumption, Production and Different Utilization of Honey from Antiquity up to Now

There are numerous references and many works have already been dedicated to this subject. In the introduction to the sensorial analysis, the reader will find a few quotations that illustrate the consumption of bee products over the years.

The history of honey is identical with the history of mankind. It undoubtedly has been one of the first glucoside foods used by man. Moreover "harvesting" wild swarms inspired prehistoric artists. Wonderful frescoes illustrating these activities of primary beekeeping still decorate some of our caves. Then, very rapidly, at the same time with the birth of religions, bees and honey were sacramented. Mythology consecrated it as food and moreover as medicine, considering honey as an important ritualistic symbol of offering.

None of the ancient civilizations seemed to ignore it. *Pharaohs* from Upper Egypt dedicated a true cult to bees and their product; these always held place of pride among the offerings brought to the deceased kings. Honey had been used during that legendary epoch as food, as medicine, but also as a cosmetic product and conserving agent. Honey consumption at the court of Ramses the IIIrd was phenomenal, the epoch documents evaluating it at more than a million jugs during the great pharaoh's reign. In India where perhaps the cradle of the domestic bee is to be found, honey was revered. According to Hindoo faith anyone who ate honey became rich, powerful and happy.

The Chinese civilization appears less fanatic toward honey; other sources of vegetal saccharose were explored there in ancient times. Despite all this, honey was used in medicine and some considered it as a drug conducive to immortality. In *ancient Greece* honey was very much praised. It was considered as privileged food for gods and kings. Hypocrates, the father of medicine, prescribed regular honey consumption for maintaining youth and for prolonging life. He himself ate honey daily. The *Greeks* attributed numerous virtues to honey, among which that it strengthened visual acuteness. Honey was also the emblem of gentleness and eulogy symbolized by Plato. The well known thyme honey from the Hymetus mountain is undoubtedly the oldest known denomination. Numerous works and treaties inherited from the hellenistic civilization, referred to honey. We find, for instance, the definition of a "good honey" described by Dioscorides. It is without doubt one of the first genuine sensorial descriptions we know of this food. "The best honey", the most valued, is sweet, penetrating and perfumed, of a pale yellowish colour. It is not liquid but coagulated, then thickening. As for the *Romans* Vergil immortalized honey as a "celestial gift" and Pliny devoted many chapters to it in his "Historia Naturalis". Even the great Horatio, in "Ode to Bacchus" praised the virtues of the "yellow treasure of the bees". When a

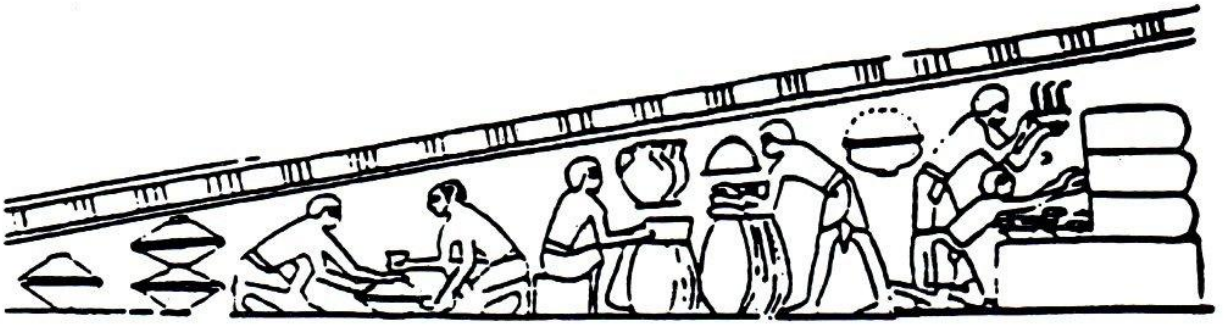
honoured guest was received in a Roman home he was offered fresh honey. The gift was meant to defend the guest's health and ensure him a long life. When Caesar's armies left for expeditions, hives followed with the attendants, so that the conquerors had their rations of fresh honey. After all, beekeeping was a major industry in the Roman Empire. The bee's product served frequently as exchanging currency. The Romans, big honey consumers, used it combined with alcoholic beverage. Our ancients, the *Gauls* imitated them in these practices, in case they themselves had not transmitted them to Rome. It is a well known fact that hydromel was the favourite drink of Vercingetorix's contemporaries.

Honey was also used for a very long time in other parts of ancient Europe. In *England,* for instance, there was a flourishing barter trade, in which honey represented one of the safest references and this happened a long time before the Roman invaders' arrival. An old Saxon alcoholic beverage, undoubtedly a forerunner of beer, was produced on the basis of honey. In *Germany,* too, the use of honey as food had an old tradition, many centuries before Christianity. Some Phoenician travèllers even described that in the country-side some popular meals were made exclusively out of honey, bread and beverage made with honey. This demonstrates the existence of an abundant production. Taxes for the land's masters were payed in honey. In *France* honey was a traditional food along with bread and milk. The tax on bees was a medieval habit so that the local landowners gathered important taxes from the exploited hives, as well as from swarms captured on their lands. In all *Slav countries Russia, Poland, Yugoslavia* honey represented one of the most important basic foods. These traditions remained very much alive and the product of the bee is still extensively used in cooking, pastry, mixed with different ingredients as well as in alcoholic beverage. Finally, in the *New World* the domestic bee did appear very late, introduced by the Spanish conquerors; aztecs and mayas already used successfully honey produced by some local small bees, melipones. They used it for their offerings, but that also served to pay the king's taxes.

All mythological gods were honoured by offerings and it was seldom that honey did not appear among them. The references to bee products are numerous in all religious texts. *In India the god Krishna* was symbolized by a bee and the name "Madhova" means "born in honey". In *Rig Veda,* the oldest among the sacred books of India the divine virtues of honey are consecrated. In *Greece* the gods in Olympus were offered a mixture of honey and milk. This magic drink was called ambrosia. According to the legend it was prepared to feed Zeus, father of gods and the bees' king. His descendants, Greek and Latin divinities, as Ceres, Dionysus, Hecate, Jupiter, Apollo, Mercury, Aphrodite and Proserpine benefitted by the same offering, as well.

Honey is frequently quoted and praised in the *Bible.* We already know that Moses' famous metaphor "that wonderful country where

I. Fig. 1 — *Picture on the Spider cave walls near VALENCIA in Spain. This scene illustrates harvesting of a wild swarm practiced many thousand years before Christ. Wild honey was certainly very much appreciated. It constituted the only concentrated glucic source man enjoyed during that very far away epoch.*

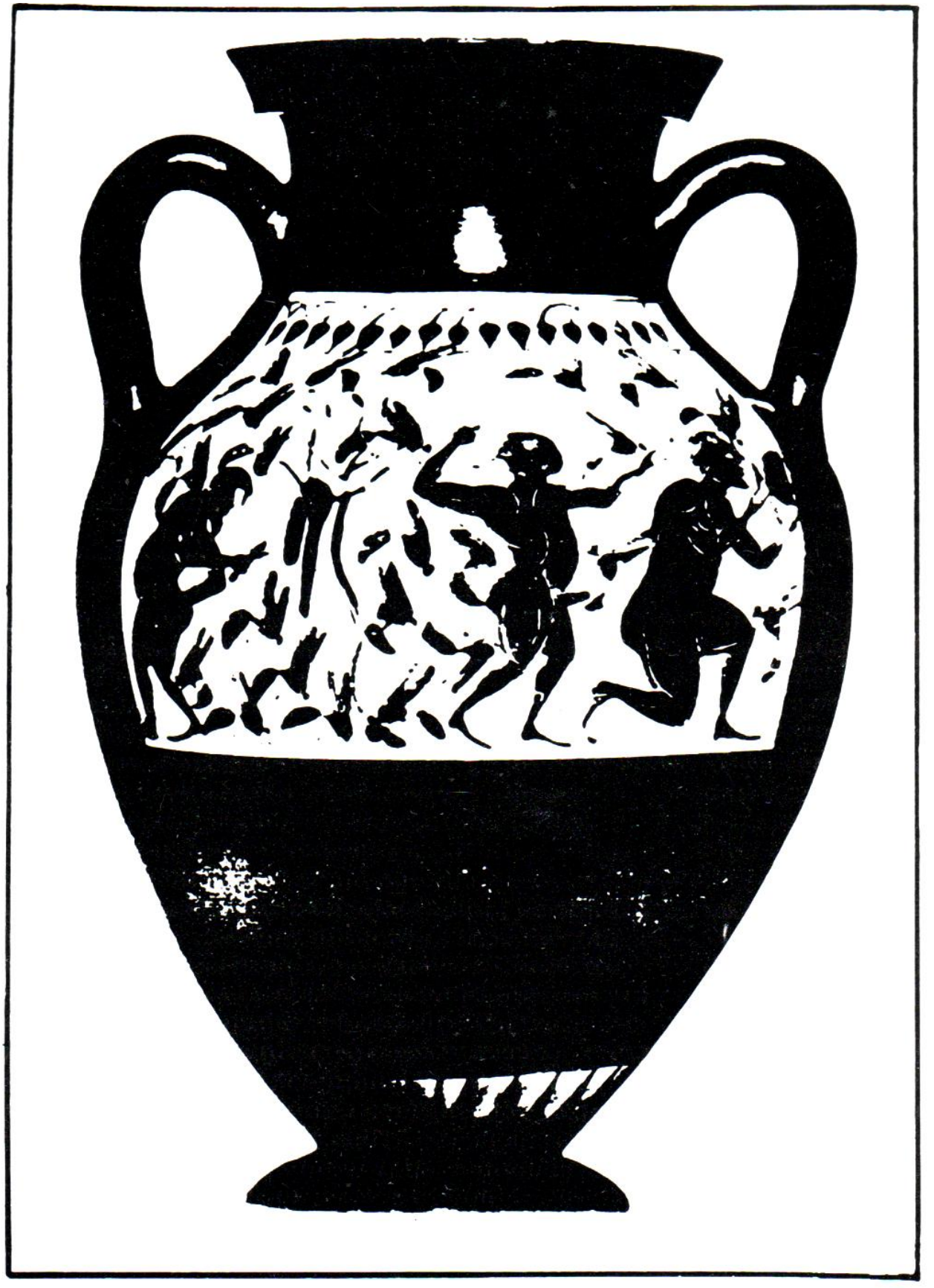


I. Fig. 2 — *Bas-relief on REKHAMARA's grave (1450 B.C.) in Thebes. A true beekeeping scene is described in the image. It could be entitled "honey harvesting and conditioning in ancient Egypt". The two Egyptians on the right extract honeycombs by smoking the hive. Those in the centre prepare honey by pressing, filtering and squeezing it. Finally, the others fill and seal the jugs that are going to serve as an offering.*

I. Fig. 3 — *Offerings carrier: The plate kept in the right hand by this Egyptian contains honeycombs. Those few bees that still forage on them characterize the nature of the offering, pointing out its importance once again (Grave 101 from Thebes). Reproduction "An apiary is born" (Un rucher nait") R. Alphandéry.*

milk and honey flow" is resumed and developed time and again in the Old Testament. Some of Solomon's proverbs refer to honey:"The fiancé's lips are sweet as honey...", "Eat honey, son because it is good and sweet for your palate"... This last verse can be interpreted as a test for sensorial appreciation. The *Talmud* proclaims the medicinal virtues of the bees' product. The trade in honey was a flourishing one with the ancient Jews. This noble food constituted the most refined gift and was offered to the strongest in exchange for their protection. Also in the *Gospel* we find a lot of symbolic references to honey. So that in the Gospel of St. Luke, Christ revived appears in front of two of his disciples on Emaus road. He asks them: "Do you have any meat ?" They answered: "Broiled fish and a honeycomb (flavus mellis). Finally, the *Muslims* used honey quite a lot. The prophet Mahomet recommended to his faithful to eat honey. Among the celebrated aphorisms we can quote: "Doctor's remedies are bitter, those sent by God are as sweet as honey"; "Honey is the body's remedy but the Koran is the soul's remedy". The concept about Paradise in the Koran is in fact "a river flowing with honey". Honey consumption was warmly recommended to those faitful to Islam not only for its nutritional and curative virtues, but also because it brought luck. Finally, the Arabs consider that honey makes you strong and virile.

The symbolism of honey always remains associated to sacrosanct, pleasant and beneficial activities. The origin of these traditions is lost in the mist of time. We find it with all civilizations from the Far East to Black Africa. Honey, an offering to the gods, enjoyed a sacred power. It also symbolized nature's purity and nobleness. It was certainly considered as food and medicine, but also as a talisman, protector from demons. Effectively numerous creeds and habits referred to honey. It played an important symbolic role *in all ritual ceremonies* that consecrated *birth, marriage* or *funerals* and that is valid for all religions. Therefore, for Babylonians, Egyptians and Jews the first food with which the new born's lips were moistened were milk and honey. The Indians used to anoint the male descendants with honey at birth. Identical habits were registered with the Slavs and the Anglo-Saxons. But, nevertheless, during the *nuptial ceremonies* the use of honey was the most largely spread and this was true for all civilizations. It symbolized good luck, happiness and prosperity to the couple, banishing the evil. Honey was often offered in association with milk, bread and wine. During the wedding ceremony in India, the bride was anointed with honey on the forehead, mouth, eyes, ears, as well as on genitalia, as a guarantee of fertility. In other parts of Central Europe the nuptial rings were dipped into honey as a blessing before uniting the couple. Sometimes the bee's product served as a traditional gift offered by the suitor to his future parents-in-law. They accepted the foreigner or rejected him according to the quantity and quality of his offering. In Sweden and Finland at big wedding parties meals were and sometimes still are served entirely based on honey



I. Fig. 4 — *Greek amphora from the VIth century B.C. (Antikenmuseum — Basel). The Cretans entered the cave of infant Zeus, ate honey dedicated to him and got drunk with hydromel. They were punished by attacking bees that stung sensitive parts of the body (reproduction from Gazette Apicole)*

I. Fig. 5 — *Romans offering honey to CERES, the harvest godess (ALPHANDERY Drawing)*

I. Fig. 6 — *Traditional wild honey trading in a Thai market. Small indigenous bees gen. "Apis florea" are those that constructed these combs, raised their brood and stocked them with provisions (Photo, Imkerfreund 1981)*

and hydromel as beverage. Here and there we still find today reminiscencies of these ancient habits. With the Muslims, for example, especially in Morocco, where honey is considered as an aphrodisiac, future spouses eat a lot of honey before the wedding night. Here too,symbolic and mythical belief plays a great role because in other places it is said that honey would be a strong soporific and is eaten by those seeking rest. Finally, we will also quote the familiar and universal phrase translated into all languages "honeymoon". In popular imagination it follows marriage and is synonymous to a sweet and happy period. The use of honey at *funerals* or commemorative ceremonies is also a habit rooted in antiquity. The Chinese and Babylonians, Egyptians, Greeks and Romans used it. For the Egyptians the body's death did not mean at all the disappearance of the soul too, and honey represented food for it. Many pots filled with honey were placed near the Egyptian kings' sarcophagues. The pharaohs' famous honey was therefore a reality; numerous documents and frescoes attest it. Some even assert that jugs with honey in a good conservation state have been found in the pyramids. This information seems to be unlikely because honey containing the fragile saccharose degrades quickly enough. The dark and viscous substances discovered could be oxidated vegetal oils. Honey, symbolizing purity served also to purify the bodies and souls of the deceased and lead them to eternal happiness. According to some beliefs bodies conserved in honey would have been revived. So that at their death great kings and dignitaries of Babylonian, Assyrian or Persian civilizations were dipped in a coffin full of honey. Alexander the Great was undoubtedly the most celebrated sovereign that had such a burial.

We have little original information on *the use and consumption of honey in the Middle Ages and during the historical period preceding ours.* Of course, the tradition of honey as medicine has been perpetuated but in this field it has had a serious competitor: vegetal sugar extracted from sugar cane. Sugar cane was introduced and its cultivation developed in China a few centuries before the Christian era. Greeks and Romans knew it and described its extracted juice as "a kind of honey" but it seemed that it did not mean much to them. We find a few old chronicles from medieval Europe, especially Germany and England, that refer to the use of sugar extracted from cane as food. It was an exotic sweet consumed in the royal saloons of the period. In fact, this very appreciated juice, used as medicine too was very expensive, a lot more expensive than honey. Before the exploitation of sugar beet, molasses was imported and its price was very high for some juices that undoubtedly could not have been well preserved. Therefore we had to wait for the XIXth century in order to witness the development of the sugar industry; then honey was definitely replaced. In connection with this we also specify that the feeding reflex of regularly eating "sweets" in large quantities is a contemporary phenomenon that expands concurrently with the exploitation of beet and the manufacture of dehydrated sugar. As to honey, it has always

been a nutrient and mythical medicine in high demand; a product of great nobleness and high symbolic value, but rarely an article of daily use and highly popular. In exchange, the production of alcoholic beverages based on honey greatly developed in the northern countries and in medieval Europe. In a few countries in Central Europe as Hungary and Poland hydromel has remained a popular drink even today. On the contrary, in France the tradition of Gallic hydromel was discontinued and replaced by the civilization of wine.

In this second half of the XXth century consumption of honey has developed strongly and the number of consumers is on the increase. This new phenomenon has reached especially the big income countries. The modern techniques of apiary exploitation of honey production, processing and conditioning has led to more abundant harvests, as well as to creating qualitatively better products, that has better preservation. The development of melliferous crops also fully contributed to a great increase in honey production. Finally, the modern and diversified marketing circuits made this food accessible to everyone in cities, as well as in the countryside. Only a few decades ago people ate honey when they were visiting friends or relatives who dealt with beekeeping. Nowadays the honey can be found in urban areas, in all food stores. Of course, it is poorly presented, on less accessible shelves or amidst a mass of sweets, but anyway it is sold to uninspired customers belonging to every strata of society. We note however that among all the food products honey remains one of the most traditional. More than a third of the national production of France is directly negotiated, without any intermediaries, from small producers to consumers.

It is very hard to establish trustworthy statistics about honey production and consumption, especially due to the importance of private markets that more or less escape controls. World production of honey is estimated to about one million tons a year. The main producing countries are in order: China, the United States and the Soviet Union, followed by Mexico. Almost 40% of the world production is harvested in these four countries. In the European Community the global production amounts to about 90,000 tons.

The South European countries have a well established professional beekeeping; they also have the greatest production and smallest consumption. The North-European countries produce less, their beekeeping is strongly dominated by amateurs and honey consumption is situated in general at a high level. Globally, the Community Europeans eat more honey that they produce. North-European inhabitants, as well as the Germans, perhaps except for the English, are big honey consumers: more than 1 kg. per head annually for the inhabitants of Federal Germany. In Southern Europe honey is however less valued, 300 gr consumed annually per inhabitant in Italy and about 500 gr in France. But at present these figures are constantly on the increase.

Honey consumption in France, for instance, is not constant in all regions. It is greater in the North and East than in the West and South. At the root of this difference there are undoubtedly seasonal phenomena. It is indeed ascertained that honey consumption goes up in winter and decreases in summer. When it is cold more teas and grogs are drunk and often they are sweetened with honey.

All over the world much more liquid honey is consumed than crystallized; it is indeed a natural reflex. For instance, in the Arab countries where people are big eaters of honey and often small honey producers, crystallized honey is practically thrown away. In regions where technology is developed and tradition less strong these reflexes tend to equilibrate and crystallized honey is perfectly tolerated and often sought after. But an important exception is the case of the United States. In this big country the average consumption is about 500—600 gr annually per person and they mainly look for perfectly liquid honeys (almost exclusively in the Southern states). More often these products are pasteurized and very finely filtered to be stored as such. Therefore, the homogenous and aseptical character and not tradition plays a primary role to the average American. On the contrary, in Canada and even in the northern states of the United States crystallized honeys are perfectly accepted and even in higher demand. That is a consequence of applying into practice some modern techniques of honey preparation that were developed in those regions. Nowadays, in all the developing countries honey is especially used as a welfare food. Globally, its consumption is increasing according to the couple's welfare. The essential reasons that lead to the choice of a certain honey are very different. The traditional reflex to care for and maintain one's health by eating honey is less frequent than in the past, but is still present. We can classify honey consumers in Europe and all over the world into two distinct categories with fluctuations inside every group according to more or less persistent local habit. First category: *traditional amateurs* in general the "experts". They are mainly looking for the natural product. They often prefer it in its liquid state that represents a guarantee of freshness for them and procure it by recommendation. They represent a small category, but are in general great honey eaters. These people pay in general less importance to the proper sensorial quality of the food than to the assurances about a perfectly untreated natural product that retains all its freshness. Second category: *inexperienced amateurs:* it is the most important part that tends to increase at present. Their reasons are more common. They look for a food quality, fragrant, easy and pleasant to eat, liquid, finely crystallized or even in a state of a cream paste, well presented, in transparent jars, with a pleasant colour, rather clear and bright. Therefore these consumers pay great importance to the sensorial, visual and gustative quality factors, and to more or less precise landmarks they can know about them. This is one of the reasons of the outstanding success of regio-

nal honeys, about which references can be easier obtained and have a constant aromatic quality. Contrary to the preceding one, this new generation of consumers is almost entirely devoid of knowledge about honey. That is why it is more open, more receptive to the proposed criteria of selection, as well as to the scientific and technical explanation that justify their choice. It is therefore important to supply the missing landmarks thus enabling them to fully appreciate the quality of a certain honey.

This is the very essential target of this book that can be summed up around two main points:

— first of all *we have to ensure* the promotion of honey defining and making accessible the main references about the sensorial qualities of the product,

— then *to develop a new art* of *honey tasting* to make the quality of an excellent food be much more appreciated.

This is a wholly original approach and it is perfectly in step with the current evolution of an expanding market. After milleniums of traditions and symbols honey is demythified and gradually becomes a more used consumer's product.

II. Generalities on the Sensorial Analyses and their Applications to Honeys

A) What is a Sensorial Analysis and what is its Aim?

When we eat daily we do an unconscious sensorial evaluation, visual, olfactory and gustative and, in general, superficial appreciation of the consumed foods. It is tasting in the usual sense of the word. When answering to food stimulation we objectively translate quantitatively these sensations, we perform an objective sensorial analysis. That is tasting in the finest sense of the word.

The purpose of a sensorial analysis is to first of all bring complementary information to the traditional analysis. The chemical analysis gives information on the global composition of a product, on its nutritional and possibly dietetic value, but all this is insufficient to define a food completely and objectively. Let us take an apicultural example to illustrate these assertions.

We give below the results of the physico-chemical analysis for two honeys:

Polyfloral honey	Lavender honey	Component
4.5	4.5	*colour* (Ind.Pfund)
35.8	35.5	*glucose* (%)
38.9	39.2	*fructose* (%)
0.9	1.1	*saccharose* (%)
5.2	5.0	*maltose* (%)
34.0	35.0	*total acidity* (meq/kg)
3.8	4.0	*electrical conductivity* (10^4S.)cm-1

The first is a plain polyfloral, amber coloured, not very flavoured honey, with a rough crytallization, it is a honey of a mediocre quality. The second one is a mountain lavender honey, yellowish amber in colour, very perfumed, finely granulated. It is a product with great commercial value, among the most expensive on the French market.

The elementary traditional analysis demonstrates that these two honeys are fully comparable because from the chemical point of view they are very close: hence the possibility of a hasty conclusion that they would be identical. The sensorial analysis allows for a differentiation in the organoleptic and tactile fields and justifies the superior quality of the second one.It is true that the research and identification of pollen contained in every honey would nevertheless lead us to more reasonable conclusions. But we could have chosen two honeys of the same origin, with perfectly overlading analysis bulletins; the first sample taken shortly after harvesting, fresh, very fragrant; the second one, older and after suffering a substantial loss of the original aroma. Here too the sensorial analysis represents an incomparable means of final selection. The information that it brings is therefore indispensable in confirming the product's value and in informing the consumer of possible pleasures he will experience by tasting that honey, based on the quality of the sensations this food will procure.

B) Definition and Objectives of the Sensorial Analysis of a Honey

Taking the other honey, presuming of course that you are not going to throw it away from the very beginning, one can have two kinds of different reflexes that otherwise are not incompatible.

The FIRST REFLEX: to eat honey with the main reason to feed yourself, to care for yourself or, merely, to satisfy one's craving. It is a mechanical act without a precise analytical research. The SECOND REFLEX: to do a genuine tasting of honey, namely to eat it but,at the same time to appreciate it and translate this appreciation into objective data which can possibly be transcribed in classification terms, of different stages. This is called a sensorial analysis,it is an *authentic intellectual act* that resorts to an exceptional measuring but fragile apparatus, delicate and susceptible to frequent deregulation: the human being.

The expression of this evaluation is done by analogy or comparison with often unconsciously memorized sensations.

The formation of a honey master will especially consist in considerably increasing this memorizing capacity, following his constant training.

By the sensorial analysis of a honey *different objectives* can be attained:

— completion, as we have seen, of the results of the physical, chemical, biological, pollinic analysis with data of the organoleptical and tactile analysis;

— enabling one to better appreciate the product that already presupposes to know it better, that in turn, allows one to defend and sell it better and to judge it more objectively;

— finally, to be able to harvest honey under the best conditions, to better "prepare" it, correspondingly preserve it in a satisfying state of freshness till marketing time, and to eliminate from the market those honeys that can be legally sold but are of inferior quality. Last but not least, it is a concrete study in technology that concurs with the qualitative improvement of honey, to its own and the beekeeper's promotion.

C) Phases of Tasting

Honey tasting operates in three successive stages. Every stage corresponds to a normal reaction that everyone can have in front of a food product and especially honey. You LOOK AT IT,then YOU SMELL IT and finally YOU TASTE IT.These successive phases VISUAL, OLFACTORY and GUSTATIVE are dominated by complex phenomena of sensations and transfer of information from the receptors' level(eyes,nose,mouth) to the brain.These sensations determine the intervention of chemical, physiological and tactile stimuli. We will not enter into the details of these very complicated and partly unknown phenomena; we will be content with a rapid study on different stimulated senses and on the characteristics that are perceived.

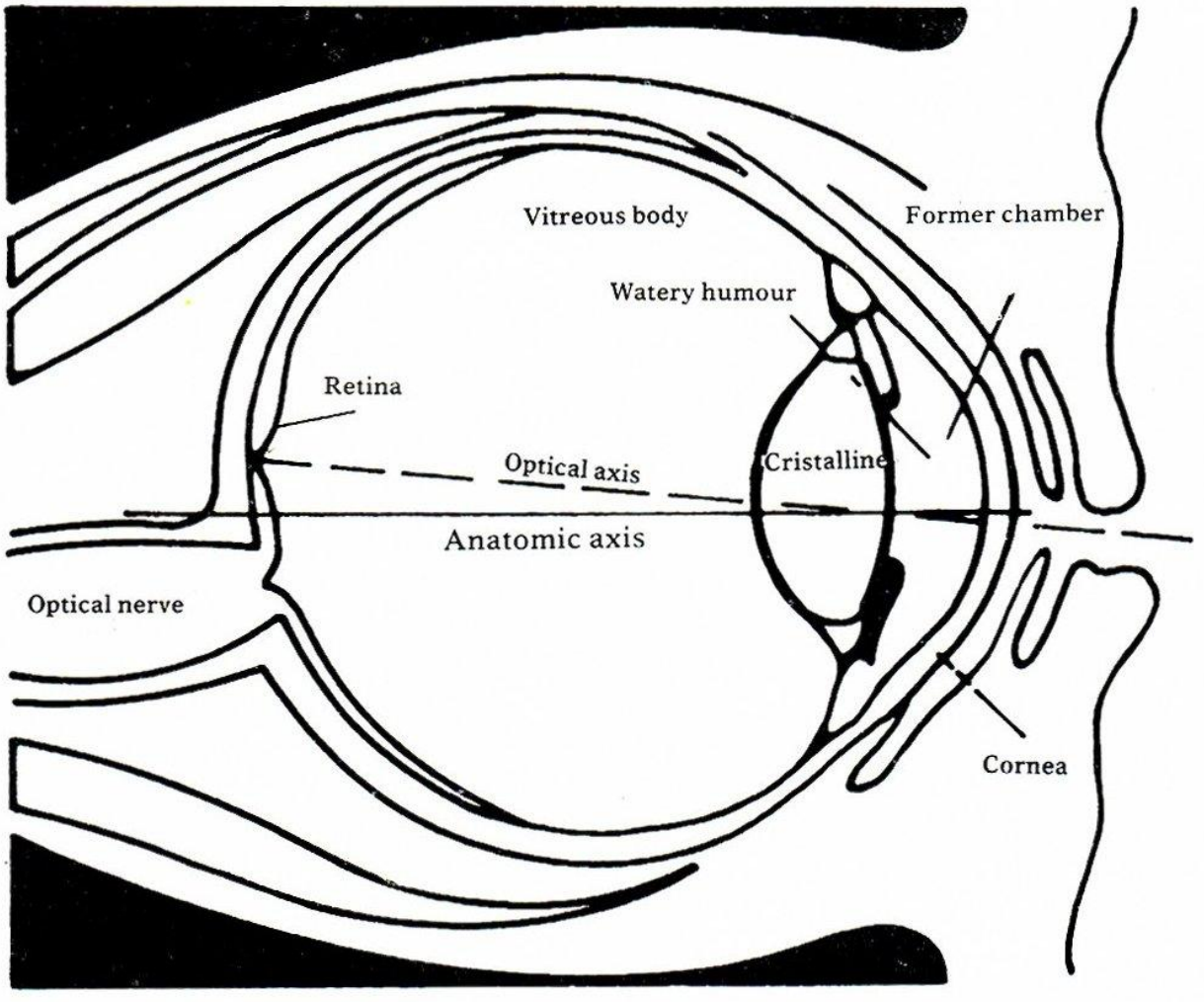
D) Used Senses and Sensations: Perceived Characters (table 1) and Fundamental Interpretation Difficulties

a) Visual sensations

They are received by the eye from light stimuli. When we observe a food, its main character is colour: it depends on the bright radiations absorbed by this food. Quality, as well as used light intensity influences colour perception, hence the importance of these two factors in the sensorial analysis. Cleanliness, homogeneity, certain types of faulty crystallization or the crystals' size are also criteria of appearance that appeal to the visual sense.

We should note that a crystallized honey that reflects light to a great extent appears necessarily clearer to the observer than the same product in a liquid stage because, on the contrary,the latter absorbs radiation. This phenomenon is verified with old honeys of the same origin, but crystallized into different structures (fine and rough for instance). They do not reflect the same quantity of light and that is why they can appear as different products. The sensorial perception of colours through visual appreciation is therefore very subjective.

There is measurement apparatus to attenuate this eye insufficiency but it does not give precise information in case the product is



II. Fig 1. — Visual sensations: *the eye cross section*

The eye perceives light and due to the optic nerve transmits the respective sensorial excitation to the brain where this message is decoded.

Endowed with six muscles linked to the bony ocular wall through its movement the eye allows perception of the objects situated in different places.

To explain the functioning of the eye in a simple way, is compare it to a photographic camera. Schematically, (see Fig. 1 above):

— light rays penetrate through the cornea;
— they pass through the watery humors, saline liquid;
— after they cross the pupil, reach the cristalline and the vitreous body;...
— they finally reach the retina (5 cm^2) which is the seat of visual cells.
— The image that forms on the retina is conducted by optical nerve under the form of impulses, to the brain.

The eye perceives colours or more likely the different light waves as different stimuli. It perceives separately the light rays issued by every point of an object that makes the perception of the object's forms possible.

The eye is permanently active:

— the adjustment of the pupilar diameter as a response to illumination;
— accomodation of crystalline convergency;
— jerky movements meant to refresh the image on the retina.

Man's sight represents approximately 40% of the sensorial entries and proves to be the main information source.

But our visual sence is subject to frequent quite normal optical illusions. For instance: contrast phenomena, image persistance, geometrical, size and comparison illusions (Figs. 2 and 3).

liquid or reduced to this state (see Chapter IV). The taster has to keep in mind that criteria of appearance are always the first to be perceived in chronological order and that their impact is permanent

Table 1

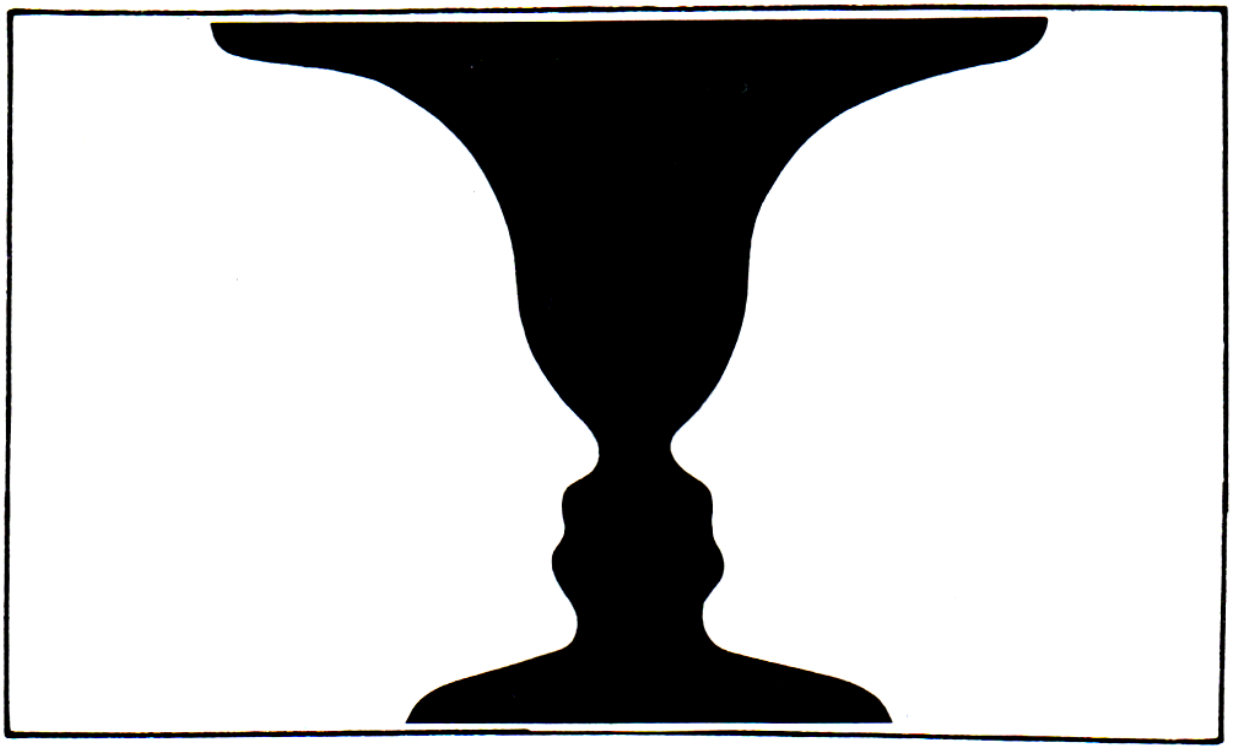
Senses used in the sensorial analysis of honeys

Organ	Senses and sensations	Perceived characters	
Eyes	— sight — visual sensation	— colour — fluidity — cleanliness — general homogeneity — certain accidents of crystallization	Appearance
Nose	— smell (direct nasal way) — olfactory sensation	— smell	Smell
		AROMA + TASTE	
Mouth	— smell (retronasal way) — gustatory sensations	— aroma	
	— taste	— flavour or proper taste	Taste
	— mucous reactions — usual chemical sensitivity	— bitterness-astringency — acidity — burning	
	— tactile sensations	— firmness, unctuousity of the crystalline mass — granulation (crystal size)	
	— thermal sensitivity	— temperature	Touch

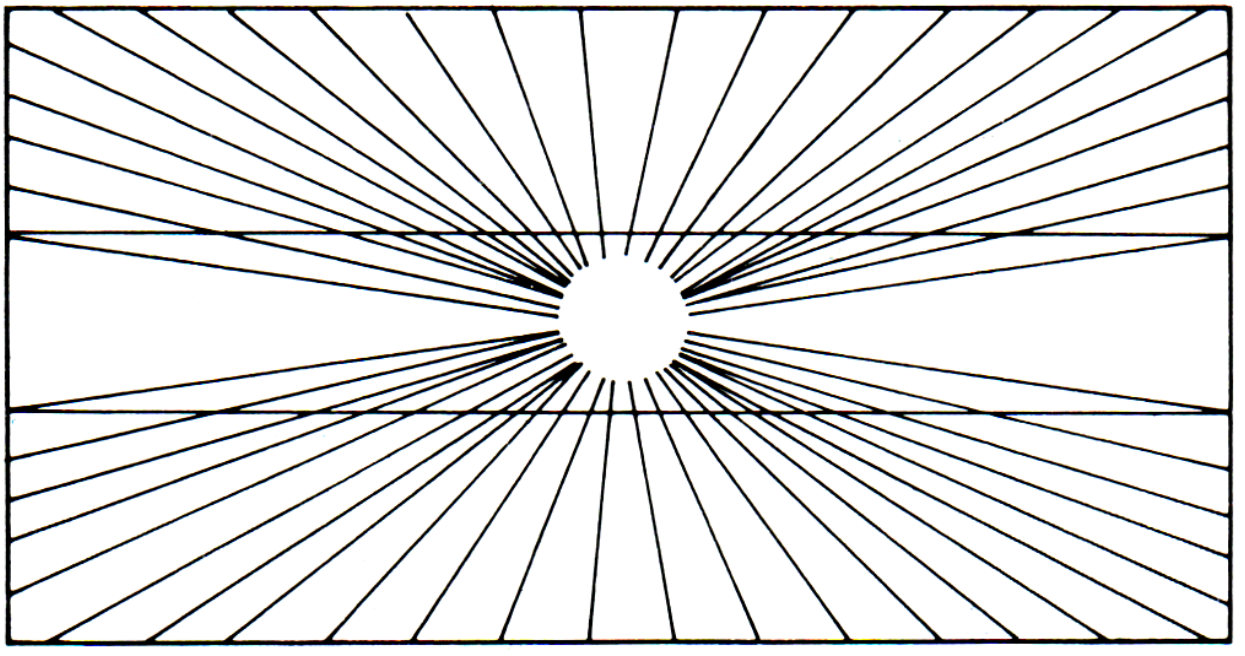
throughout the tasting. This is the reason why they are given so much importance. "The sensorial universe of man is essentially visual, this is probably the reason why the physiology of vision holds such an important place in sensorial physiology"(GAUFRET 1984 — in ENSBANA notebooks).

The interpretation of reconstituted image starting from the perceived bright stimuli is generally rapid and easy. We have the necessary language and knowledge at our disposal to do that. Therefore man is highly confident in his visual sense. It is said that you do not believe it if you cannot see it, but we have to admit that the eye is not always a "faithful friend" (fig. 2 and 3 perfectly illustrate this "deceiving appearance" phenomenon). It can lead to errors of appreciation as demonstrated above. To learn not to draw hastly and premature conclusions, especially following the visual estimation of colour, is a

fundamental behaviour that the taster should appreciate. Yet it can happen that certainty acquired from the information received at this level is sufficiently strong to totally distort the interpretation of other sensations when those are required. To avoid this trap it can be useful "to leave aside" colour before practising the olfactory and gustative proofs by working in red light and tasting from coloured glasses.



II. Fig. 2. — *Optical illusion (contrast phenomenon). What does this picture represent? A black vase, without doubt; but also two white faces. The eye cannot perceive simultaneously the two images : as soon as one appears, the other recedes.*



II. Fig. 3. — *Geometrical illusion. Two perfectly parallel lines cut the geometrical design illustrated by this rectangle. The eye perceives two oblique lines.*

b) Olfactory sensations

They are important in tasting. But it is also a sensorial modality frequently difficult to explain.

When one breathes normally, one's average air flow capacity reaches 100 ml/s with an expelling speed rate of about 1 m/s. When smelling, these gaseous exchanges are strongly accelerated and the olfactory perception sensibly increases ; then we can distinguish the nature of smells.

A volatile organic or mineral molecule, that disseminates into air can be filled with an odorous message. The smell diffused as such is breathed in through the nostrils and will determine reaction in the olfactory perception cells found on the upper part of the nasal fossa, just below the skull. This sensitive mucous membrane covers a reduced surface of about 2—3 cm^2. Pigmented yellowish brown, it is formed, on one hand, of a neuroepithelium that shelters three types of distinctive cells and, on the other hand, by a submucous membrane where neuroreceptorial axons are regrouped into olfactory nerves. These neuroreceptors, having a density of 30,000 per mm^2, extend themselves with mobile olfactory cillia. This entire sensitive tissue is always dipped into a mucous liquid. Protected from excesses by the hornet, the mucous membrane receives only filtered air, heated as much as needed and humidified. It perceives the chemical message of smells when these are dissolved in nasal mucus. The olfactory neurons are directly linked to the brain crossing the cranial bone.

Intimate mechanisms of the transfer of smell stimuli to the brain through the olfactory nerves and then the return of the decoded information, are very complex and neurophysiologists' explanations are still experimental; that is why we will not insist upon them.

Nature has been generous and provided us with several dozens of millions of olfactory reception cells. Sometimes we loose their use when suffering of rhinopharyngeal diseases, for instance, but fortunately this precious function is very rapidly recovered. The olfactory cilli, as well as the neuroreceptors, are continuously renewed, there is therefore a permanence of olfactory cillia-and neurogenesis in humans. This is an exception from the relatively intangible biological rule that provides us from birth with a stock of neurons, that inexorably diminishes with age.

Our capacity to perceive smells, even very limited ones compared to that of the dog, or the pig, for instance (more than 30 cm^2 of sensitive mucous membrane with the latter) is not less extraordinary if we relate it to the infinitesimal quantities of aromatic substances sufficient to provoke sensations (the limits of human perceptions are situated around 10^{16}—10^{17} odorous mixture in the natural gaseous complex). No apparatus, irrespective how sophisticated, would detect and moreover measure such fractions.

Smells are very complex and the component volatile substances can be studied, but this does not mean that we will be better informed

on the sensations that can be revealed only by an experimental smell.

Olfactory sensations are neither fix nor durable, they are frequently received in a discontinuous way. So that after extensive breathing and best reception of smells their intensity will decrease and sometimes disappear, especially when they naturally are not very strong. They will reappear after a rest phase. The olfactory perception varies very much from one person to another; sometimes you can see even partial or specific anomalies (smell absence).

The number of smells that man is able to recognize is estimated at 10,000, leaving one speechless in connection with his capacity to describe all these sensations, however perceivable. For instance, in a product as complex as honey, just one, two or three dominant smells at the most can be analyzed and recognized by the olfactory way.

In the olfactory practice, we should breathe in air that contains volatile particles for many seconds at a slow and gasping rate. The adaptation phenomenon is very important and after getting acquainted with the most intense primary smell, a secondary one could be perceived. The odorous molecules can be instantaneously perceived at their optimum threshold or after a few seconds and several repeated breathing-in exercises. This depends especially on the concentration, as well as the volatility degree of the smelling complex, but, without doubt, on the taster's sensitivity.

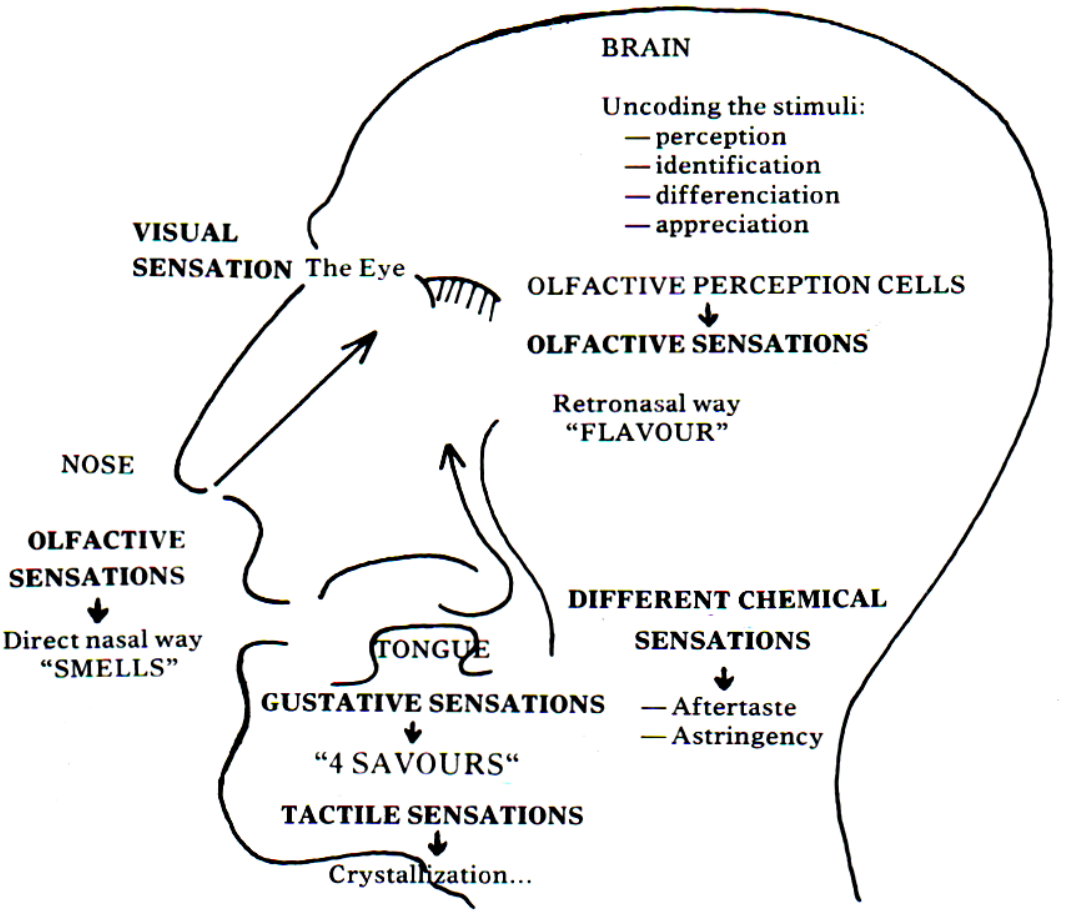
There are two possible access ways to the olfactory mucous membrane that are illustrated in fig. 4:

— *the direct nasal way* passing through the nostrils and here we refer to smells;

— *the retronasal way*, via the rhinopharinx and then generally aromas are those referred to.

Aromas are perceived when the product is in the mouth and this takes place at the same time with other gustatory sensations, giving rise to a certain kind of confusion. Therefore during tasting, the retronasal olfactory and gustatory sensations generally determine the taste of food. But we will speak more precisely about aroma+taste when the perception of the complex "smells-aromas" is discussed.

The same person can have a very different perception threshold, depending on his need for that product. Smells and aromas are formed of partly identical volatile elements for the same product. In spite of this, the sensations produced are not always of the same nature and frequently they are not sensed with the same intensity. This fact is due to different perceptive ways, but also to the quality and quantity of the released molecules. The lightest molecules are the most volatile and they are felt especially through the direct nasal way. The aromatic molecules are the heaviest, they are emitted only in the mouth, when the product is brought to the body's temperature; the complexity of it is then intensely perceived through the retronasal way.



II. Fig. 4. — *Sensation centre*

Smell is an important sense that people do not trust thoroughly and most often do not use well. It is true that we are not in possession *apriori* of a precise language to define smells and aromas perceived especially in honey. However, an approximate description of a certain smell can be done by seeking for analogies with well known references; for instance, the perfume of a plant, fruit or an animal. The perceived odorous stimuli are not decoded and spontaneously translated. We have to use our imagination, but also to gather a lot of references and perfectly memorize them, to be able to reach that point. "The nose memory" is therefore hard to get and, generally, it remains indefinite.

To all these significant difficulties one can add the very pronounced affective character of sensation as well. One likes or dislikes a smell according to different personal influences of psychological or cultural origin. Perception of a smell can cause among some pleasure and appetite or, on the contrary, can generate disgust and rejection. From this point of view, it is not possible to be very objective, of what the olfactory appreciation is concerned.

Yet exercising your "smell", practicing "smell hunting" in nature, learning to recognize and appreciate smells is the best school for educating this fundamental olfactory sense, that most of our contem-

poraries — always in a hurry, never available, no longer living to take their time —, lose unrelentingly.

We possess a few good olfactory references to get used to elementary smells and memorize them as it should. They are presented as vials that contain specific smelling extracts which will be smelled. These vials are placed in a box that looks like a book binding. So that there are "collections" of elementary smells of some natural products, as "the wine smell","the mushroom smell", "aromatic herbs and spices smell". Especially in this latter box there are a few reference smells that are close to the natural smells perceived in honeys. (LENOIR J.).

c) Gustatory sensation

Human beings have among 7,000—8,000 gustatory buds, grouped into 500,000 gustatory receptors, spread especially on the tongue's surface, palate mucous, the back of the mouth, epiglottis and pharynx:

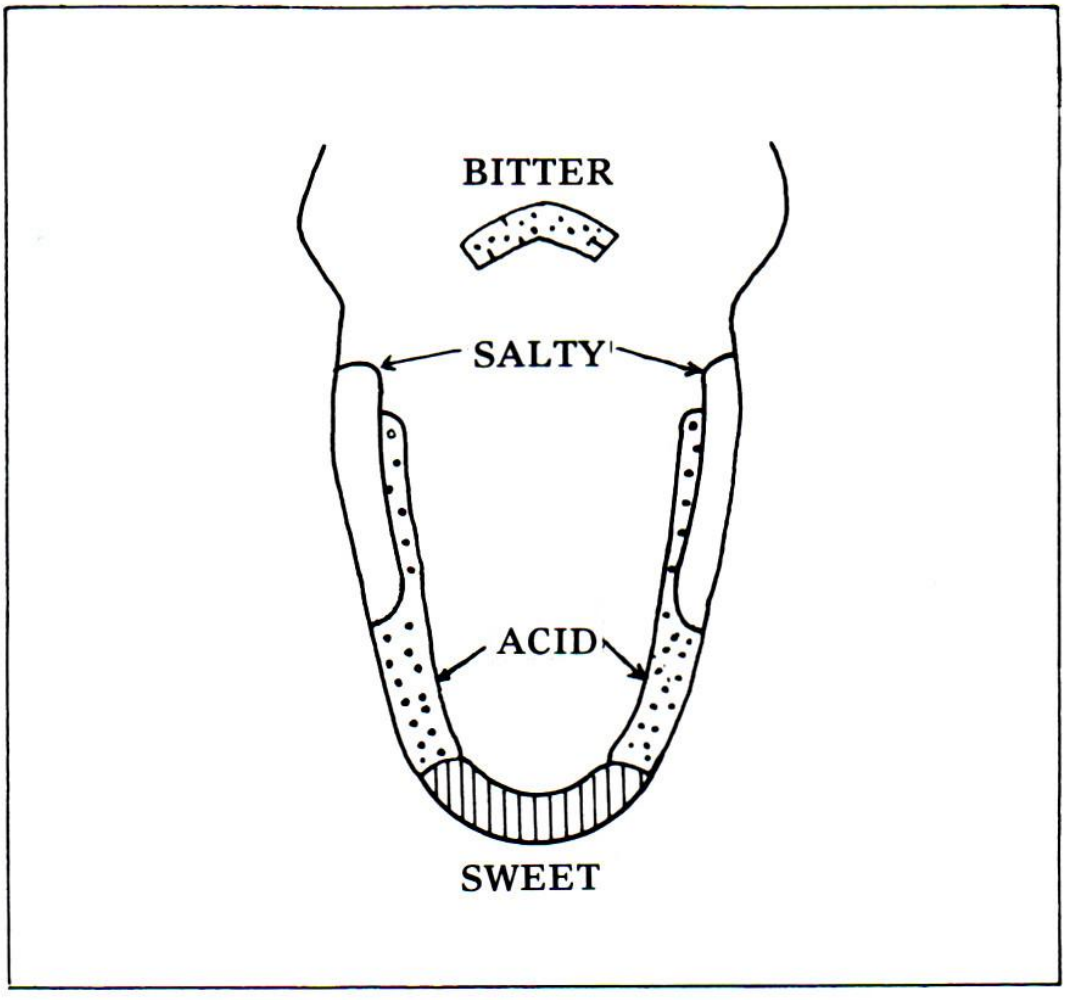
— filiform papillae without buds;
—fungiform papillae on the fore tongue;
—foliate papillae, scarcely and lateral;
—finally, calciform papillae, that form the lingual V at the back of the mouth.

These gustatory cells are renewed every 7 to 10 days (the phenomenon is called turn-over). These receptors are sensitive to 4 basic savours that strictly belong to taste (sapidity): acid, bitter, salty and sweet. They are heterogenously spread on the tongue, but the optimum perception zones can be approximately defined.It has been ascertained that a large part of the tongue proves to be insensitive. (Fig. 5).

ACID SAVOUR: is given by acid chemical bodies. Not all acids are perceived as such in honey and there is no precise relationship between the perceived acidity when tasting and the pH or the total acidity of the product. Certain honeys are nevertheless characterized by natural acidity, sensibly greater than others; that is revealed by a slight pinch sensed on the tongue's fringes. A fermented honey or one beginning to ferment can also be perceived in the same way.

BITTER SAVOUR: is that of quinine or cafeine salts. These substances belong to the polyphenol family, which can be found in a very small quantity in some honeys; the best known in Europe is that of chestnut tree and *arbatus*. Bitter savour is very characteristic; it is perceived only on the posterior part of the tongue, on the V lingual level. It is therefore felt just at the back of the mouth, when food is swallowed.

SALTY SAVOUR: is that of sodic chloride or some other mineral salts. It is not perceived in honey that is very slightly mineralized.



II. Fig. 5. — *Perception localization of the four savours on the tongue.*

SWEET SAVOUR: is found in most of the *oses.* It is very exacerbated in honey where fructose (main sweet constituent) has a sweetening power two and a half times higher than glucose and one and a half times than of saccharose. "The sweetening power" is not equal in all honeys. It varies according to the product's composition. The ratio among the different sugars and the content of mineral salts are fluctuation factors at this level. Among the gustatory sensorial features that allow the identification of honeys, sweetness (strong or less strong) is an important criterium that should be valued.

Recent studies tend to demonstrate that the gustatory space, from the qualitative point of view, proves to be vast and more complex than what the physiologists have upheld up to now. The four basic savours we described above that constitute the essential basis of taste physiology are not so elementary as it is believed, but belong to some kind of a "sensorial *continuum*" as in colours that have seven basic semantic descriptive terms but in fact form a continuous ensemble. Therefore, we do not have a "semantic descriptive term" in order to qualify certain special tastes, that can be placed in between two basic savours.

d) Different chemical sensations

These sensations are in demand for the sensorial analysis of honeys in a quite exceptional way. Sometimes natural causes determine stimuli. It is, for instance, the case of astringency.

It is a construction, a passing ruggedness of the mouth mucous. Just like bitter savour, this sensation is provoked by polyphenolic bodies and is, in fact, often experienced at the same time with bitterness. Tannins are those generating this phenomenon and, for instance, chestnut tree honey is reputed to be slightly astringent. Accidental causes could also determine these chemical sensations.

Let us quote the bitterness experienced at the back of the mouth and at the beginning of the pharynx in case of a honey with "smoke taste".This is a typical example of what often happens when bees are driven off honey when harvesting with smoke from old sacks. This type of sensation is often qualified as the "taste left after consuming" (see chapter V).

e) Tactile sensations and somestasia

Recent studies led to a new and complementary approach to the sensorial physiology of tasting. There are the so-called conscious sensations, occasioned by stimuli of a mechanical or a thermic nature. These phenomena of "somestasia" allow one, for instance, to assess texture and viscosity of a food triturating, compacting, displaying it with the hands or in the mouth. Texture appreciation, especially in the buccal phase, appeals to the mucous and tongue mechanoreceptors. These tactil sensations are especially required in honeys. They are perceived with the lips, palate, gums and, in a more global way, in the complex of the bucco-pharyngian ensemble. It is a mechanical act. Unctuosity, firmness of crystalline mass, granulation type of a honey are revealed by touch.

The tactile stimuli can be decoded and translated into concrete language: fine, coarse crystals; paste structures that display cohesion etc... but, in general, they will be received and interpreted especially in affective terms. A velvety honey that melts in the mouth is eaten with pleasure and can cause the most vivid pleasure to the taster, especially if it is combined with an aroma appreciated in the same way. On the contrary, a coarsely granulated honey, that irritates the mucous and causes a cough, will be considered as unacceptable and will cause a rejection phenomenon, even if the product develops a very pleasant aroma.

From this point of view the global sensorial appreciation of honeys in relation to the tactile appreciation poses a fundamental problem linked to the structure of the products that have to be compared. Therefore a honey in liquid state and crystallized honeys with diffe-

rent structures are differently appreciated. Aromas will be perceived more or less intensely according to the sample quality and the honey's dissolving swiftness. Yet honeys should be compared in the physical state they are at sampling time. This is a specific technical difficulty to the type of tasting. Yet training and experience allow for this problem to be overcome.

This is one of our investigation objectives.

III. The Sensorial Apparatus and Tasting Conditions

A) The Sensorial Apparatus

It is drafted in fig. 4 of the previous chapter; the following reception organs are used: eyes, nose, mouth. Stimuli are conveyed in a complex way to the human brain. It centralizes, decodes all the received information which derives from different sensations (see table 1). It is a fragile "apparatus" undergoing frequent deregulations; often data brought by it are not reproductible. But in honey analysis the sensorial apparatus is not a replaceable tool. But it can be improved to a great extent; the quality of analysis and appreciation that results from it are granted by intelligence and acquired knowledge, and its superior affective character also allows a nuanced translation of the information received. Nevertheless, in order to aptly function and to bring worthy responses, it requires conditions of rigorous utilisation, a long and serious preparation and permanent training.

B) Conditions for Using the Sensorial Apparatus

When dosage is made in the laboratory, we generally have an "apparatus" and "a method". There is a way to use the apparatus, the method has been described and if the indications are properly followed one can get results that can be reproduced any time. For the analyses made in the tasting room, the serving apparatus is the human being for whose utilization a note having the following summary can be imagined:

— *description, functioning principle and the origin of sensation;* namely the study of the anatomy and physiology of senses;

— *usage means,* learning the sensorial physiology and conditions in which it will be applied.

The conclusion is that the sensorial apparatus will provide correct and reproducible measurements only under very precise functioning conditions. Variability causes in appreciation are numerous: in order to considerably attenuate its effects three important parameters need to be taken into consideration during a first stage:

"*Environment*" resulting from the feature of the room where the tasting is taking place, as well as the adjacent installations;

"*Material used*" for tasting;

"*Identity*", as well as "*physiological and psychological differences*" of the taster.

a) Environment

A room should be:

— fairly *sound proof;* street noises or noises coming from neighbouring rooms or ill-timed discussions between tasters induce distraction, disturbing intellectual concentration;

— *without smells:* parasitary smells, pleasant or unpleasant, of cooking, fresh paint, smoke, fuel etc. are not desirable when their emanations fill the atmosphere in the tasting hall;

— where a *pleasant average temperature* around 20°C is predominant. Extreme environment temperatures, cold or hot, lead to the numbing of senses and generate distraction;

— where *environment humidity* reaches 60%. Smells are hard to be perceived when the rooms are too dry or fungical smells are released;

— that should be *correctly lighted:* day light proves to be the best, but in its absence, an incandescent light could be chosen that does not change colours, contrary to fluorescent light (a luminosity between 200—400 lucs is indicated);

— *with pastel coloured walls,* neutral and restful (light green, beige etc...). Vivid colours can be sensed as too agressive or too shocking to the eyes; they will distract the taster;

— that last but not least has appropriate installations, as it is practiced in wine tasting. We can imagine either:

— a *multi-purpose hall* where there are: tables with plates of a neutral colour (light grey or white to avoid parasitic reflexes), comfortable chairs, neither too soft to prevent sense apathy, nor too hard to avoid the taster becoming uncomfortable, or

— *a specialized hall* allowing for every taster to be isolated from his neighbour by vertical, lateral and front walls. This individual hall has also, except for the back chairs a mini sink, a swan-neck water tap. This device allows every one to do his own evaluation and exercise a personal judgement avoiding any external influence.

b) The used material

Especially in the case of crystallized honey, the judgement on its appearance requires the presentation in original always anonymous jars. But the olfactory, gustatory and tactile examination is achieved on a sample put into a glass. This is composed of:

— a *cup* or receptacle, honey is going to be put in. The rounded

Table 1

Neurophysiological Modalities in tasting

1. Reception organs of senses . . . . . meaning —eye, —nose, —mouth } are stimuli centre
2. The resulting sensation is transmitted . . . . . by nervous cells (neurons)
3. to the decoding organ, the brain . . . . . that can be the response of some successive phenomena:
4. perception . . . . . (with different thresholds according to people), then eventually
5. identification
6. differentiation
7. appreciation . . . . . of the tasted product.

Some definitions

— *Stimulus* (stimuli): physical or chemical agent, able to induce reaction in the sensorial recepting organ.

— *Sensation:* subjective reflex phenomenon, following stimulation of the sensorial receptors.

— *Neurons:* nervous cells that transmit sensitive signals to the brain and spine, then direct the received indications to target regions.

— *Perception:* sensorial acknowledgement, interpretation of sensations.

form of the cup favours smell emission and accumulation;

— a fine *stem* or rod, sufficiently long enough to allow for the glass to be grasped;

— *support* (sole), on which the glass stands on a flat surface and will allow it to be held and then manipulated between thumb and forefinger.

In order to stir honey during the olfactory examination and to extract the necessary quantity from the product to be ingested a spoon of neutral plastic will be used, preferable to wood or metal ones, that often present difficulties of some inconvenient smells or contacts. The finger, the natural spatula that most beekeepers use, is a tasting tool not to be recommended for elementary hygienic and cleanliness reasons, and also because the epidermis is never neutral and the interfering phenomena can be numerous.

In order to avoid supersaturation and sensorial fatigue too early, following a saccharose supersaturation, in the resting breaks, the taster is invited to eat a *juicy apple,* slightly accidulated, but without a piquant taste or excessively green.

c) Identity, as well as physiological and psychological differencies between tasters

In spite of the different perceptive sensitivity between people the intensity of the investigated characters is in general situated above the perception threshold. To limit the risks of an erroneous appre-

ciation data linked to the following phenomena should be kept in mind:

— *sex:* men and women can prove equal tasting capacities. However it is considered that ladies' sensorial acuity would be somewhat more developed than that of gentlemen. This is a general statistical data, undoubtedly correct, but it is far from an established fact and every time verifiable at sample level. It is also said that female answers are in this field much more inconsistent than the male ones and this depends on natural and transient physiological situations that can exacerbate craving and accentuate performance or, on the contrary, can generate disgust that do not incite to gustatory analysis;

— *heredity:*it can bestow special aptitudes upon certain tasters. Our inheritance in this field does not escape the genetic laws and from their birth, individuals are more or less endowed with basic sensorial resources. Nevertheless the fact that one is born with them does not exempt him from working and we will have the occasion to talk further about that;

— *age influence:* olfactory, but especially gustatory perception, diminishes with age. But experience, knowledge, training will more than compensate this diminishing acuity;

— *momentary conditions:* they are numerous and can be caused by:

— all respiratory tract illnesses, chronic or acute (running noses, sinusitis, bronchitis, asthma) that considerably limit the taster's capacities;

— liver and bile disorders distort olfactory perception and can be accompanied by sickness which annihilates any appetite;

— intense smells following some buccal treatments that make the mouth insensitive;

— different body ailments that inevitably provoke a lack of concentration;

— a state of excessive stomach supersaturation that generates a state of sleepiness. It is not at all advisable to practice tasting after meals, especially if they have been rich and abundantly wined;

— the intensity and aromatic persistance of certain foods, of what had been drunk before tasting, especially appetizers digestives, coffees or different tonics. Coffee, for instance is completely forbidden to the taster an hour before a presentation is going to take place;

— using a toothpaste with a strong and persistent flavour and anesthetical effect; by chewing gum, drops or other sweets which have colorants and artificial aromas with strong and durable smells in their composition;

— an excessive use of perfumes (aftershave, lipstick, nail varnish, creams, perfumed soaps) by some tasters. The same thing is true for clothes that emanate a strong smell, such as those of leather, or velvet;

— taking drugs, medicines that act upon the nervous system or

by abusive use of tobacco. Used in a moderate dose, it seems that tobacco has only a slight influence upon sensitivity; on the contrary, and as a general rule, a chain smoker is always a poor taster, although even in this case training allows to partly compensate acuity loss. One never smokes in the tasting hall and tasters who smoke are advised to avoid tobacco at least one hour before tasting;

— the tasting schedule; it is preferable for the taster to be hungry in order to perceive and better judge smells and savours. The most favourable time is between 10—12 a.m.

— by an intense physical and intellectual fatigue that makes every nervous effort very difficult. This fatigue can come in the wake of previous work or simply of a far too long tasting meeting. In this sense the examination should not go beyond 15—20 samples; beyond this number physical and gustatory fatigue due to saccharose hypersaturation can give birth to a lot of confusion;

— a physical weakness, that can be merely a lack of calm, a passing or permanent excitement, phenomena always detrimental to the necessary concentration. Sometimes it can involve graver psychopathological problems linked to genuine behaviour phenomena that place a question mark on every judgement pronounced.

In short: the best conditions for a successful tasting are the following: to be healthy, rested, sober and available.

C) How to Become a Taster?

It is neccessary to follow a training course in order to become a taster. The taster should:

a) Get a certain number of data:

— *on the product:* its physical and chemical composition;

— *on technology:* to allow him to connect effects to causes;

— *on man's anatomy, physiology* and *psychology* to better understand the functioning of the sense organs and the sensation process;

— *on tasting methodology;*

— *on vocabulary:* few works have been dedicated to establish the vocabulary necessary in the sensorial analysis of honey;an indispensable work of research and harmonization of terms remains to be achieved. It is possible to express a judgement only by comparison to what was memorized, hence the need for a great number of references and an appropriate vocabulary. We present in Chapter VII, as a table, a descriptive attempt on monofloral honeys.

b) To impose himself a certain discipline:

1. Moral: the taster should not seek personal satisfaction by the

judged samples. He is required to provide an objective, impartial judgement, that proves difficult and urgent; after all, he has to persuade the others that he is a judge who determines other people' pleasure and in his verdict he implies the beekeeper's work.

2. Technique: in order to get sufficient competence, the taster should necessarily:

— do an apprenticeship involving a course in theoretical and practical training that would allow him to get the pattern of sensorial analysis. For this training, samples should be usefully provided to test and improve the judgement which should be repeatable, to teach the taster how to avoid "traps" and thus free himself from the impact of preconceived suggestions and ideas;

— to get training also aimed at bringing up to date the experience achieved, as an athlete proceeds in order to maintain his training, the taster should carry out permanent exercises; he will enrich his mental references by memorizing, renewing them when needed. This training will also contribute to the maintenance of a good functioning of the sensorial apparatus and will increase resistance.

In short for training a good taster, should be a person possessing average perception and identification thresholds, with a sound voluntary and stubborn judgement; knowing how to concentrate, is to be preferred to a very gifted person, as far as his olfactory and gustatory acuity is concerned, but insufficiently attentive and less motivated. After all, a good taster will be somebody that knows well the possibilities and limits, masters his senses and knows how to maintain himself in a perfect condition.

D) Circumstances of Honey Tasting and Types of Practiced Analysis

The sensorial analysis of honey can be done under different circumstances also for a lot of practical and experimental reasons. Here are some of those.

— The gustatory evaluation practiced by the beekeeper or competent businessman himself on a sample coming from a batch of produced, sold or bought honey. In this case it is important that a safe evaluation is made that will be possibly completed with the results of the classical analysis.

— The sensorial analysis according to regulation made by an official panel entrusted with approving a quality label or a national or regional trade mark.

— Tasting made at regional or national competitions by specialized panelists.

— Sensorial analysis that validates classification of a honey into

a monofloral category.

— Sensorial analysis with a pedagogical character made at a training course.

— Finally, experimental sensorial analysis achieved by experts. It should allow, for instance, a safer and more complete definition of the perceived organoleptical characters, as well as of the natural gustatory variations registered according to the honey's origin. It is a complete descriptive study that can be achieved by using two types of investigation.

1. An analysis of differentiation that resides in the comparison of 2 or more samples aimed at finding out if they are identical or different; underlining possible differences and with a subsidiary title, noting the taster's preference.

2. A more complex *evaluation analysis* that uses registration, classification, objective, subjective or hedonistic description.

We will return to these analyses and their application in the following chapters.

E) The Taster's Behaviour

The taster exercises a serious function and should not improvise. During tasting his behaviour and reflexes have to be perfectly mastered.

He has to be calm, unruffled and concentrated on his subject. Any demonstrative attitude on his part should be avoided, as well as any subjective and personal comment on the product currently under analysis. The taster is in fact the expert by excellence. If he expresses his content or discontent through a rictus or exclamation he can falsify the result of an analysis as the other less experienced members of the jury risk to rally to his suggested appreciation. Only work and experience will allow the taster to acquire this indispensable mastering of his behaviour.

But as the taster is no robot he can show personal satisfaction or dissatisfaction through his verdict. The hedonistic appreciation is that linked to pleasure or displeasure. It is a purely subjective and affective touch that the taster leaves more or less in almost all sensorial analyses. The translation of this appreciation is desirable but it should be certainly done with shades of differentiation and be tempered. An experimented taster by adaptation can do an appreciation that tends towards objectivity even if his personal preferences are favourable to another type of honey; it is a transposed hedonistic appreciation. In practice, a competent subject can objectively appreciate a honey or a series of lightly coloured honeys of acacia or alfalfa even if his preferences favour darker and much more fragrant honeys such as chestnut or heather honey.

F) Choice and Formation of a Honey Tasting Jury

For honey evaluation competitions the jury is traditionally chosen without taking into consideration sociological or psychological data; generally beekeepers are chosen people that are not supposed to know the product very well. Once this choice is made the "experts" are not always a guarantee of impartiality. Sometimes producers or traders with a long experience in beekeeping can prove to be in the posession of good knowledge of organoleptical characters, but are limited to a few types of honey. Without an effort on their part to remedy this insufficiency they will excel in judging and classifying honeys they already know and furnish mediocre appreciations and results for other honeys because they do not know them well enough or have some preconceived opinions.

If we take into account all mentioned criteria it deems necessary to make a selection of juries. It is absolutely necessary that the chosen tasters can free themselves from all conditioning linked to their habits, social status, traditions and this is not easy to be achieved.

They also should prove some physiological aptitudes in exercising a sensorial analysis. It is preferable, for instance that individuals who have attended a training course be chosen whenever possible. When we have representatives from a lot of socio-professional categories it is desired to harmonize the juries' composition by chosing producers, businessmen, technicians and consumers' representatives.

For honey competitions one can resort to a lot of juries each of them containing an odd number of tasters, usually three, five or seven.

Here we deal with the question of the taster and tasting jury but we will return to the subject of honey competitions in the last chapter. Do these competitions contribute to quality improvement? Are they a promotional device? In a word do they present any interest? We will try to answer all these questions.

G) Description of the Proposed Tasting Technique for Honeys; Its Limits

Thirty-forty grammes of honey are taken out of their original packing and put into already described glass (paragraph B/b of this chapter). The choice of this glass is important. It is our innovation and is aimed at achieving a standard method and establish the best possible conditions for the gustatory analysis. All samples are presented having the same thickness and in the same observing and smelling conditions. The jar of honey habitually used for tasting presents many disadvantages. First of all the sample is not always identical, the form and nature of the jar, the thickness of the honey layer

are variable considerably prejudicing and often limiting observation work. Then smells are very badly perceived because the air volume above a full jar is necessarily reduced due to these circumstances; therefore the concentration of smelling molecules is poor and they dilute very quickly into the surrounding atmosphere. The only advantage by using a jar is that, when it is transparent, the general homogeneity of its content can be appreciated, and so can be certain presentation defects.

Honey samples are presented for tasting at a uniform temperature, that of the place where the tasting is taking place. When we deal with a crystallized and hard honey this can be cut with a knife into compact blocks to point out its structure. The sensorial analysis operates in the already described sequence; honey *is looked at, smelled* and *tasted.*

In the visual field colour, cleanliness, homogeneity, as well as possible crystallization defects are noted. We know that it is necessary to balance the information received through simple observation. This latest approach discloses important signs but we should not draw conclusions too quickly.

Olfactory stimulations are obviously complex and lead to the recognition of the different fragrant components in honeys. The tasting method proposed at this level is the following: One takes hold of the stem of a sample glass. With a plastic spoon the honey is stirred and then the glass is brought to the nose while slowly breathing in, long enough but without forcing it, and time and again. The answer to smelling stimuli appears only after the dissolution of the aromatic molecules into the nasal mucus. Thus very often and depending on the aromatic threshold of honeys the first smells will be retained only at a second or even a third breathing. Then a few gramms of honey are taken out of the glass, put into the mouth, progressively dissolved and projected toward the back of the buccal cavity. Then the aroma is perceived from the olfactory point of view but by the retronasal way. This second stage should renew, specify and complete stimulation received by the direct nasal way. But the aromatic perception of honey generally proves to be more intense than the direct olfactory perception because the product, warmed up at body temperature, releases more fragrant molecules. This aromatic perception can be fugitive or persistent; this should be retained because it is one of the aspects of the floral quality in honey. Essential information gathered through smelling should be remembered and, if possible, transcribed. To this end the perceived smells and aromas have to be qualified according to known references or lacking those most often by comparing them with personal and familiar memories.

The gustatory stimulations are varied, they can be perceived in a complex way. They are the fundamental savours of the product. In honeys the sweet savour is obvious, always very strongly perceived, but also one of acidity or bitterness. Aromas captured by the retronasal way unleash gustatory stimuli as well. It can be a "more or less

pronounced taste left after eating it" in general persevering and disagreeable...

All these gustatory stimuli called "mouth sensations" constitute in fact *the taste of honey.*

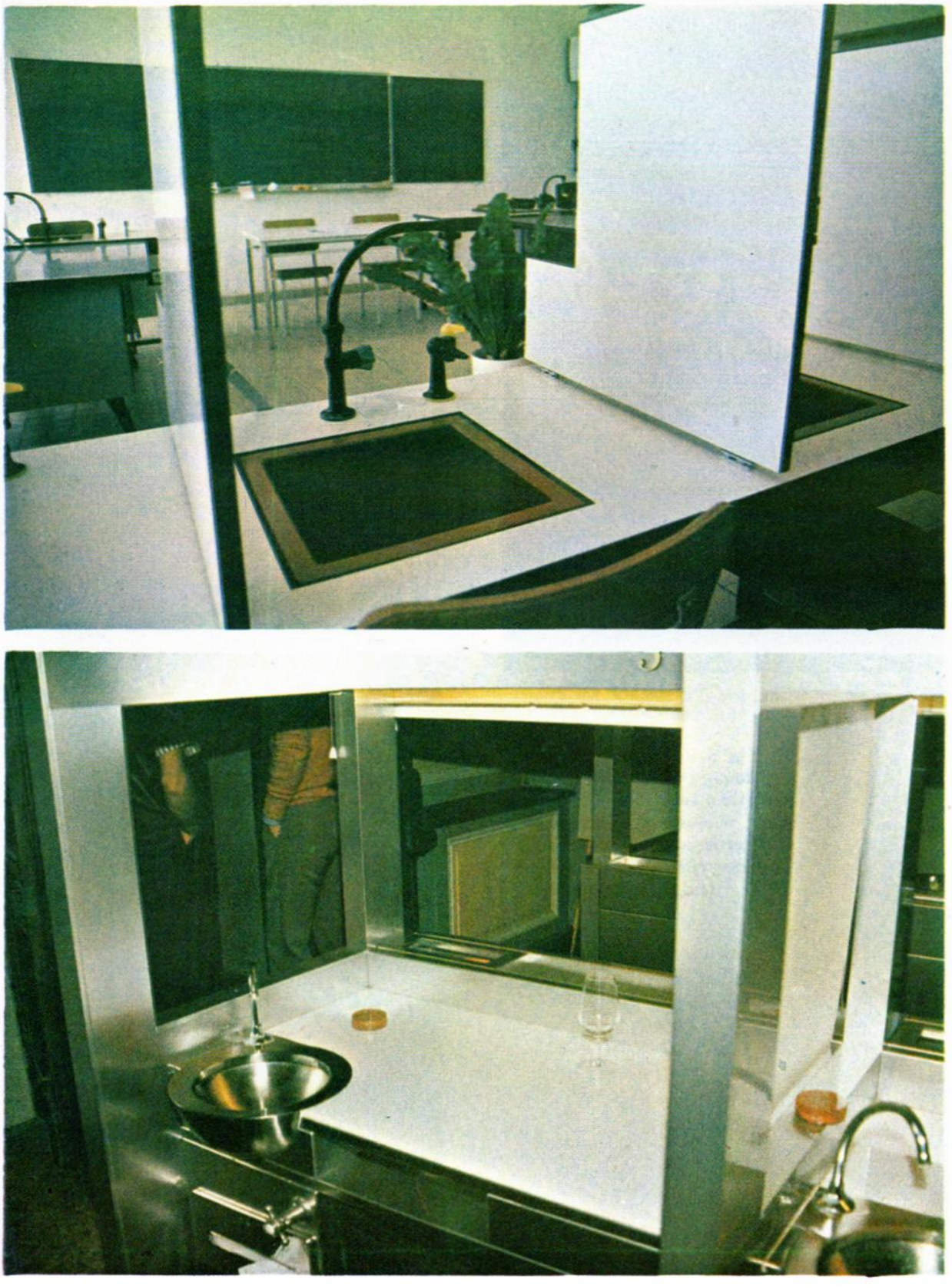
Finally, the tactile stimulation interferes when we slowly crush a small quantity of crystallized honey between tongue and palate. Then the unctuosity or firmness of the crystalline texture is directly appreciated. The presence of fine, medium, rough, round, pointed, ungular crystals is thus detected. These crystals can irritate the throat or can be annoying for the palate. Otherwise the tactile reflex is required for the first time since taking the sample out with the flexible spatula. A fine and creamed honey can be easily taken, while in case of a stiff and granulous one, this is hard to do.

In general gustatory appreciation of honey can be done on two successive samples, one for studying and memorization of all proper gustatory compounds; the other for the tactile analysis.

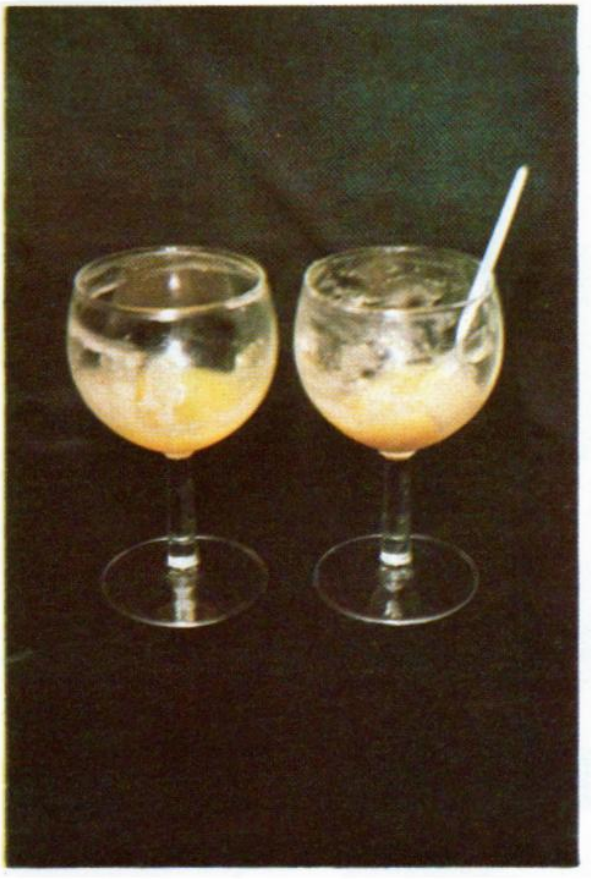
After the analysis of three or four honey samples we advise the taster to take a break and eat an apple.

Even with a continuous training and imposing himself a very strict discipline, by tasting only twice the same sample and taking breaks regularly, it is very hard to taste and analyze more than twenty honeys within the same session as a phenomenon of satiety and inhibition appears. The threshold is different depending on individuals but above this number the obtained results are confused and do no longer present the desired guarantees of seriousness.

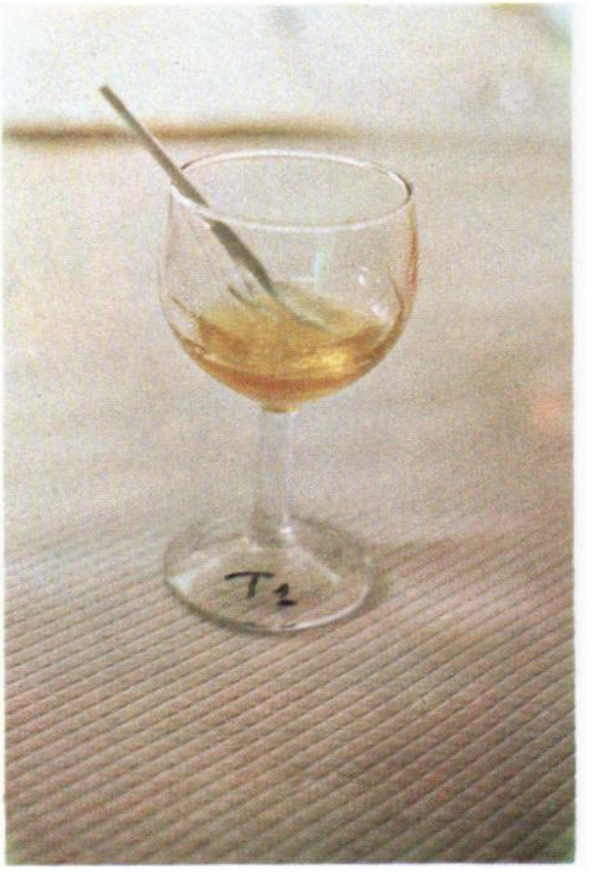
When describing senses and sensations perceived during tasting, chapter II includes technical details that are a useful completion of the already described method.



III. Fig. 1, 2, 3, 4 — *Tasting halls specialized for the analysis and sensorial control of wines: every taster is isolated from his neighbour and has a small working surface, a sink and running water. Light can be adapted to eliminate the colour of wines (a red wine and a white one will have the same appearance in this case), or on the contrary, to stress it. This type of installation is very appropriate for the sensorial analysis of food products including honey (Photographs G. Vache and M. Gonnet).*



III. Fig. 5, 6 — *Liquid or crystallized honey that is to be tasted, is put into a stemmed semi-balloon glass. The sample is taken out with a teaspoon of neutral plastic material. (Photographs G. Vache and M. Gonnet).*



IV. Criteria for the Sensorial Analysis of Honeys, Different Tests Conducted and Developed during Practical Courses; Followed by a Summary Analysis of Tasters' Answers

A) Appearance

This is the ensemble of visual features. They are very important in the sensorial analysis of honeys because most often the bought product is judged according to what is seen. The main characteristics perceived at this level are: *cleanliness, clearness, fluidity, homogeneity* and *crystallization.*

a) Cleanliness

Honey has to be perfectly pure; wax remnants; insect fragments are all visual deficiencies that can start a defective crystallization and bad conservation of honeys. Cleanliness is also judged at packing level. Jars have to be clean, both outside and inside, they have to be not too full, to avoid overflowing.

b) Clearness

A liquid well purified honey should be clear. Nevertheless, honey that is in the crystallization process is more or less persistently turbid, for a few days to several months depending on the product's composition and storing temperature. It means a faulty appearance of the product. To avoid this undesirable effect honey will be preferably sold while in a stable physical state: liquid or crystallized.

c) Fluidity

Acceptable honey (between 17 and 18% humidity) has increased viscosity at a usual temperature (20°C) of 150—200 poise. This viscosity varies especially according to the water content of honey: it de-

creases quite a lot concurrently with the increase in the product's humidity. At more than 19—20 percentage of water honeys become fluid and their viscosity at 20°C does not exceed 30 poise. They "flow" like water. These products conserve and crystallize badly, change and degrade rapidly. They are of an inferior quality.

d) Colour

It is the most important appearance criteria from the commercial point of view. It is the only sensorial examination that makes the object of a precise legislative codification. *The reference unity is the Pfund:* this expressed in cardinal notation varies between a reference of 1 or smaller than 1 for the lightest honeys and 14 for the darkest ones. Measurement is done with visual graders, specially made for honey: thus the Pfund Color Grader — or Lovibond apparatus with a conversion scale in Pfund index. Colour is a normative data of regional honeys; the excess or sometimes lack of colour leads to the disqualification of these products.

e) Homogeneity

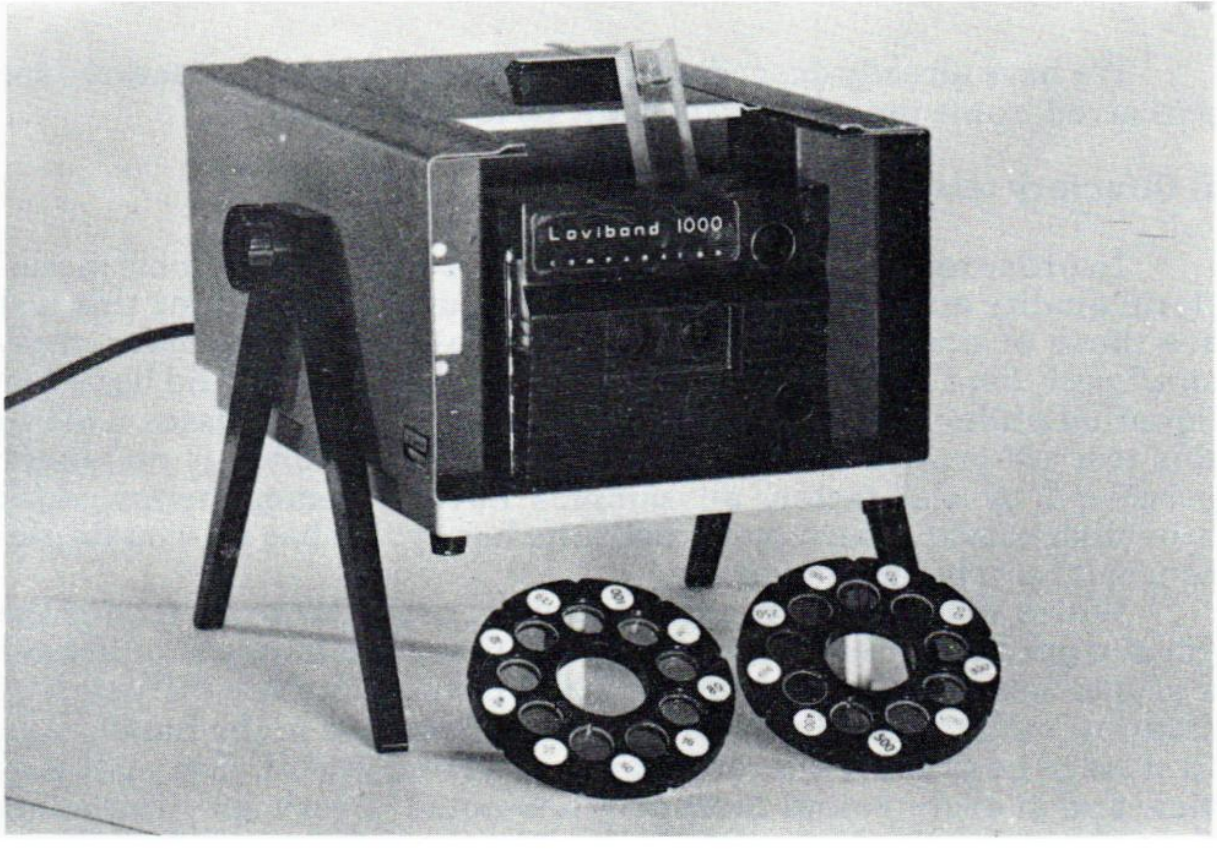
A recently harvested honey, extracted and conditioned as it should be, either liquid or crystallized, is in general homogeneous from the commercial point of view. It can sometimes happen after decantation and especially after mixing more batches of different origin, that layers of colour and different shades appear in the honey mass. Other accidents that can destroy the homogeneity of honey in general originate in a defective crystallization or biological degrading.

f) Crystallization

Crystallization is a criteria of the sensorial analysis of honeys pertaining both to appearance and to the tactile field. A good look at it allows for an appreciation of the crystalline structure of honey. Crystallization can be complete or partial. It can be wholly or fragmented. Crystals that form the texture can be thick or fine.

Tests practiced in the visual field are aimed only at colour measurements achieved with the Lovibond grader (Fig. 1). This is a small visual grader equipped with two disks A and B; one for light honeys, the other for the dark ones. In the interior of every disk nine small glass pills, round and coloured in increasing intensity are embedded in a circle and placed one near the other. Every pill has as reference the international colour norm for honeys (Pfund scale). Honey that has to be analysed is poured in its liquid state into a square vat having a 1 cm side. The vat is placed into one of the compartments of this apparatus, in the other compartment the disk rotation allows the coloured range to go past. When the observed colour in the two close com-

partments is of an equal intensity its reading is done based on the reference of the used pill. Table 1 shows the correspondence between reading the Lovibond grader and the Pfund official scale. This test is easily done, but it should be practiced on liquid honey; hence the obligation to remelt the crystallized samples taking all precautions that this requires in order not to change its colour. The recommended technique for remelting is in bain-marie.



IV. Fig. 1 — *The Lovibond apparatus is using visual comparison that allows the measuring of colour. To this end colour standards are used, represented here by small coloured pills in increasing intensity and embedded in each of the above-mentioned disks*

Table 1

Honey colouring — connection between the gradation of Lovibond's coloured filters and Pfund colour scale/Colour grader

Honeys Scale A		Honeys Scale B	
Lovibond number coloured filter	Pfund conventional expression in "centimeters"	Lovibond number of coloured filter	Pfund conventional expression in "centimeters"
30	1.1	120	6.2
40	1.8	150	7.1
50	2.7	200	8.3
60	3.5	250	9.2
70	4.1	300	9.9
80	4.6	400	11.0
90	5.1	500	11.9
100	5.5	650	13.0
120	6.2	850	14.0

B) Smell, Savour and Taste

We have already described how all these complex sensations are perceived; some practical tests allow us to carry it out.

a) Olfactory test by direct nasal way

In order to do this test we select a lot of samples of typical monofloral quality and known origin. Honeys currently used for this test are those of *acacia* (Robinia pseudoacacia), *orange, lavender, rape, sunflower, lime, chestnut, eucalyptus, thyme, fir tree.* Liquid honey or liquefied under good conditions is put into a glass. Glasses used in this test are brown. Thus, the natural colour of honey is no longer perceived by the taster, all samples have a homogeneous, dark brownish colour. The taster smells the honey. He has no visual reference; it is forbidden to taste it.

With a spatula he spreads the product over a large surface of the glass to get a better emission of aromas. Glass and honey should have a proper temperature (minimum 20°C) to facilitate the diffusion of fragrant molecules. The glass can also be warmed in the hands. At a first stage honeys are therefore analysed from the olfactory point of view and at every round their origin is noted. Every specific aroma has to be memorized to recognize it when the samples will be presented again after a few hours, in disorder and without reference. Yet the organizers will strive to reserve the most aromatic honeys for the end of the test, so as not to saturate the olfactory cells prematurely.

This simple test, is already very confusing for the layman.

Step by step small perception and intensity are different according to the individuals. Moreover the memorization capacity of every

person is not identical and the achievement of personal references is the result of experience. Therefore one can only reach good results following repeated exercises. A good olfactory knowledge of different honeys is a safe and comfortable way to rapidly identify them, without getting excessively tired.

b) Gustatory tests

We have made a series of different tests at this level.

First we describe a classical and elementary test in the taster's training; it is THE TEST of the "4 SAVOURS". This test constitutes a first "standardization" of the sensorial apparatus. Then we adopted a series of tests inspired by the current tests practiced in oenology. They are TESTS called in "PAIRS" (or in "TWOS") and TESTS IN TRIPLICATE (or in "THREES"). We have developed another test: many *honeys* are *mixed,* the taster is asked to find out the dominant monofloral essence that entered the composition. Finally, a big *memorization test,* of *recognition* and *identification* is made with 10—15 different monofloral honeys.

— "*The savours" test*

Out of all composition possibilities imagined in this field we noted the following two tests that can be practiced successively.

— *The identification test of the "4 savours"*

It is very simply practiced on five successive tests:

— a glass with drinking water; it is necessary that this natural, untreated water, should always come from the same source; it would be better if a slightly mineralized one will be chosen and will serve as solvent for the 4 savours.

— a glass with *sweetened water:* in a concentration of 6 gr. saccharose per litre;

—a glass of *acidulated water:* in a concentration of 0.5 gr. tartaric acid per litre;

— a glass of *salted water:* in a concentration of 3 gr. sodium chloride per litre;

— a glass of *bitter water:* in a concentration of 5 mg. of quinine chlorhydrate per litre. After he has become used to the specific taste of reference water that can be characterized through a slightly salty or bitter natural savour every taster can be questioned to find out if he identified the taste of every sample correctly.

"*Unique series*" test method

Here presented are the glasses numbered from 1 to 10, respecting the progression enlisted in table 2.

Salty, sugar, acid and bitter solutions in the concentrations given in table 2 are prepared just before the test. Reference products are always sodium chloride, saccharose, tartaric acid (or the citric acid), quinide hydrochloride.

The taster answers according to a code and his answers are re-

Table 2

Example of presentation of 4 savours in "unique series"

No. glasses	1	2	3	4	5	6	7	8	9	10
solution concentration	water	salt 0.75 g/l	salt 1.50 g/l	water —	sugar 3 g/l	acid 0.12 g/l	acid 0.25 g/l	water —	sugar 6 g/l	bitter 2.5 g/l

corded on an unwritten grid (model from table 2)

0 no perceived savour

X perceived but unidentified savour (perception threshold)

XX identified savour (identification threshold), the definite savour is mentioned

XXX differentiated concentration (differentiation threshold).

It will then record the recognized concentration when the dozes are communicated or, more simply, are indicated through the signs + and — namely, which is the strongest and which is the lowest.

— *Tests in "twos" and in "threes"*

It is a simplified adaptation of tests in "pairs" and in "triplicate" as they are described in the listings of classical sensorial analyses.

In the first case (twos) there are two honeys A and B and it has to be stated whether A is identical to B or different. This is a simple test yet with a slight complication, both samples A and B can be presented in a liquid stage, in a crystallized stage or one liquid and the other crystallized. In this case only the gustatory character is the carrier of the information we seek.

In the second case (threes) we have three honeys A, B and C with more possible combinations. To make the test easier and avoid confused answers, we prepared two series of tests in distinct triangles (1 and 2). For *series 1* we retain only two possibilities: A, B and C are all identical or all different that in a way means a two with three components. For series 2, there are 3 possibilities as they are indicated in the following table 3.

Table 3

Example of analysis in "threes" (3 possible combinations)

Sensorial analysis of honeys

TEST IN "THREES" — Series II

There is a liquid honey (2) and two crystallized honeys (1 and 3); two of these honeys are from the same batch;

WHICH (1)?

☐ 1 and 2 are the same and different from 3, namely $1 = 2 \neq 3$;

☐ 1 and 3 are the same and different from 2, namely $1 = 3 \neq 3$;

☐ 2 and 3 are the same and different from 1, namely $2 = 3 \neq 1$

(1) Cross the corresponding slot for the appropriate answer

For each of these tests, "threes" 1 and 2 honeys are without distinction in a liquid or crystallised stage, as crystallization can be of a different nature (texture, thickness of the granules) for the same honey. In this case, too, the olfactory and gustatory characters have to be the only ones taken into consideration because two honeys of different appearance can be identical.

The safest way to proceed in order to get a good result is to keep or perfectly memorize the first sample (A for instance) and then compare the other one, or the other two with this sample that serves as reference.

These tests are made in general with polyfloral honeys without a different floral dominant. The aromatic intensity of these products should range from weak to medium. Too strong and characteristic markers should be avoided because they simplify and trivialize exercises of this type.

— *Recognition test of mixed honeys* (Table 4)

We choose as a mixture basis a honey coloured enough and containing a strong floral marker of the chestnut or lime type. Thus more batches of this reference product are prepared. A known monofloral honey is mixed in every batch but having totally different origins (for instance: rape, sunflower, lavender, heath). The chosen honeys have themselves strong aromatic supports, enough not to be completely covered by the basic product. Each of these compositions is presented to the taster who has to recognize the added honey. The reference honey can also be placed without mixing it, in the series, that should be recognized as well. When the products submitted to the test are not well memorized, the reference samples from every honey can be circulated around before the test.

Table 4

Recognition test of mixed honeys

— Four different honeys (lavender, rape, sunflower and heath erica type) were mixed each of them into a batch of polyfloral honey, having the *chestnut* as a floral base. This latter honey also appears as reference among the 5 presented samples.
— One finds again the mixed honey, as well as the reference without mixture
1
2
3
4
5

Mixtures are in general made on a fifty/fifty basis but these percentages can vary. If honey that has to be mixed is strongly aromatic, its concentration in the medium is lowered, or on the contrary, is increased when necessary. However, the more diluted the honey that should be identified is, the harder it is to be discovered in the mixture

because its specific aroma will be screened by the aromatic strength of honey that serves as a base.

Increasing difficulty thresholds for this test can be imagined and so can variants. For instance, it is possible not to indicate the nature of monofloral honeys that enter the mixtures, the taster having to identify them himself. The reference honey that serves for the preparation of mixtures can be a natural slightly aromatic base (alfalfa, sainfoin type). In this case the percentage of foreign honeys going to be incorporated will be much lower (5; 10 or 20% depending on the nature of the products).

— *Recognition and memorization test for monofloral honeys*

It is a difficult test that appeals to the taster's capacity of memorization. A series of honeys are presented about which reference is given with a denomination or with a very marked monofloral dominant. In the first stage these honeys are offered to the taster mentioning their origin. He can take notes and can have the list of the presented honeys. He will have to imagine personal references of olfactory and gustatory characters for every honey and this without taking into account visual or tactile data. In a second stage, after a few hours or a few days these honeys are offered again to the taster in a modified presentation order. Then he will have to recognize and identify them. This test can be intricated and enriched if during the second presentation a few supplementary difficulties are introduced. These "traps" are announced to the participants that will try to thwart them. If some samples from the first round are left out it becomes impossible to do a complete list through simple verification and following other criteria than olfactory and gustatory ones. As a complementary element to the second presentation two identical monofloral honeys can also be introduced, one in a liquid state and the other in a crystallized state, only one of these phases being present in the first round. Last but not least another example of useful complementary elements to this test: at the second presentation a liquid honey will be merely replaced with a crystallized product of the same floral origin, or vice versa; also the crystallization quality of the same honey can be changed. All these variations are necessary to contain the taster, looking for landmarks, to quickly draw conclusions based on simple physical or tactile differences. These last criteria are always easier to be perceived but they are not compulsory characters for honeys, that should be determined. The taster has to make the necessary efforts for the identification of honeys independently of their structure.

We have presented up to sixteen different monofloral honeys to be memorized during the same exercise. This test is very difficult for the taster, first of all due to the quantity of honey he will have to swallow and then through the effort of intellectual concentration undergone by him in order to memorize and then identify the sample. Just like the case of olfactory tests the most aromatic honeys are reserved for the end of the test.

This last test is very important for the taster to acquire the necessary elementary knowledge. *It should be repeated often.*

c) Summary analysis of tasters' answers

The quality of the answers given by the lay tasters vary depending on the nature and difficulty of the tests, as well as the traditional knowledge they can possess regarding honey.

The test of "4 Savours" for instance, allows a first analysis on the sensitivity of gustatory stimuli of every taster. The four fundamental savours are well known, recognized and memorized by all. Therefore, the perception, recognition and identification thresholds can be efficiently defined.

Differences between individuals in this field of strict gustatory acuity can be important. No matter if there are sweet, acid, salty or bitter savours, perception thresholds vary more or less. Certain tasters, distinctly sensitive or exercised, discern saccharose diluted in a proportion of 1 gr. per litre of water. The average taster will find out sugar between 2 and 4 gr. per litre; some less sensitive subjects, will discover only a concentration of 10 gr. per litre. The origin of gustatory deficiencies for a certain savour can be found in certain food habits. So that a person who eats a lot of honey can have a very diminished acuity for sweet taste. Also a person who drinks a lot of coffee without sugar risks hardly discerning bitterness.

For "twos-threes" the analysis of the answers perfectly demonstrates the sustained attention and personal experience of individuals. It seldom happens that more than one or two people (lay tasters) and this happens at courses for 20 or 25 probationers, are able to achieve a flawless result after a first series of six to seven successive tests. However, repeated tests distinctly improve performances in this field. These tests, prepared with the help of polyfloral honeys slightly mislead the taster who finds it very difficult to memorize and establish references. But, if a monofloral honey supposed to be known is strained in among the samples, the percentage of correct answers is considerably increased.

The results obtained in *the test with mixed honeys* are generally good. Tasters differentiate the basic products without too many difficulties when their average concentration is high enough (mixed 50/50). Under these circumstances if the product that is going to be recognized is satisfactorily memorized, if its specific aroma is strong enough, it can be easily dissociated from the aroma, even intense, of the reference. Yet when the beginer tasters possess the reference about 4 products that have to be recognized, the results are better than in those cases where they hold no precise information regarding them and when they know only that these honeys have already been presented for memorization. Otherwise the difficulty of these tests can be adapted to the student's training and knowledge level.

For *the recognition test of monofloral honeys* results are in gene-

ral satisfactory. The aromatic specificity of every honey is well enough marked and the answers can be established. Everything depends on the taster's memorizing capacity. Let us also add that some current honeys are already more or less known by beekeeper probationers and that, consequently, it is easier for them to identify them in a series. For this test too, the number and importance of the introduced difficulties will be established according to the auditor's competence.

In this field, the olfactory references are undoubtedly those that are established with the greatest difficulty and this for different reasons but very often related to the bad "memory of the nose". With this test we register the most contradictory results.

C) Touch, Crystallization

— Test of tactile appreciation

Crystallization of honey, its nature, type, crystal thickness can be directly appreciated by using the taster's sense. We developed some tests that allow the study of this question.

A batch of crystallized honey is divided into several parts. The first is conserved in its initial state; it will serve as reference of spontaneous crystallization. The other amounts will be remelted and reseeded or left in spontaneous crystallization after remelting. Thus, through adequate techniques, samples with different granulation and crystalline texture are prepared; this is done starting from a single honey. These different samples, five, six or seven, depending on the tests are offered for tasting. These honeys of the same origin, about which reference is given can be studied by the taster consecutively thus being able to appreciate the importance of tactile stimulation. Placed in excellent conditions he can also make a comparison and translate for himself the subjective judgement answering questions of the type: what do you prefer? (Table 5)

The taster's answers were interesting when analysed but the test was conducted on too narrow a scale and often in front of an expert public. Yet all tastes existing in nature, every preparation of crystallized honey has its followers. However, rough and medium crystallizations are almost all abandoned, the others are chosen one by one. In general, finely crystallized honeys and especially honeys konwn as "creamed" are most appreciated. It has to be mentioned that if the initial crystallization is presented as "natural" it finds more adapts than if it is said that it is "spontaneous"; here we certainly witness a modern phenomenon! In connection with the samples it has to be men-

tioned that the samples are differentiated through numbers and that the translation of granulation types is not formulated on the working record (see legend of table 5). This is just to avoid any susceptible suggestions that could falsify the taster's judgement. For the same reasons, the applied technique for obtaining a certain type of crystallization is presented only after the test. But if two successive tests are

Table 5

Working record meant to determine the taster to appreciate different crystallization types for honeys

SENSORIAL ANALYSIS OF HONEYS
Appearance criteria
Crystallization and tactile appreciation

Test 1

One will taste 5 different samples, all obtained or prepared starting from a single honey:

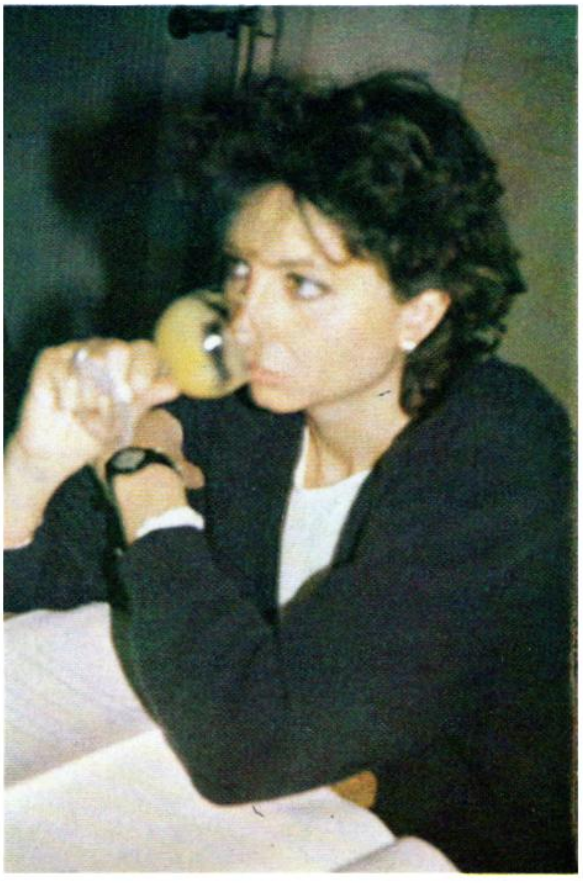
SAMPLE No. 1
SAMPLE No. 2
SAMPLE No. 3
SAMPLE No. 4
SAMPLE No. 5

The liquid honey as reference: which out of these five crystallized honeys do you think is the best?
Which one is less appreciated?
Tell briefly why?

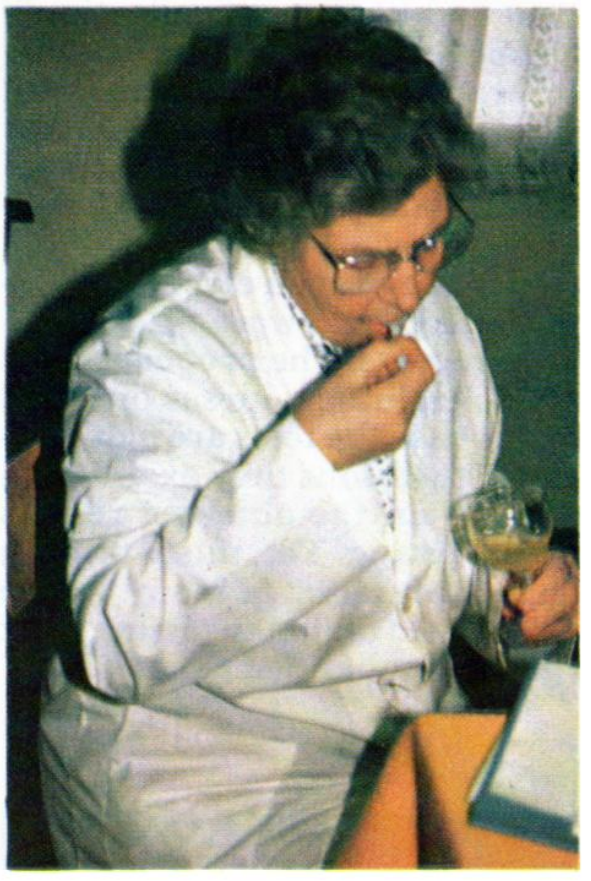
IV. Fig. 2

made on two different honeys, still using analogous techniques and preparations in the second tactile appreciation test we will not necessarily obtain identical answers to those obtained in the first. To know, for example, that "creamed honey" can be obtained by triturating the product into a homogenization apparatus fails to please some tasters even if these persons were satisfied in the beginning and when they ignored the used techniques. This proves the whole difficulty to translate these subjective and conditioned judgements. But, we have to repeat that the *finely crystallized* and "*creamed*" or "*pasted*" honeys are mostly in the lead of appreciations.

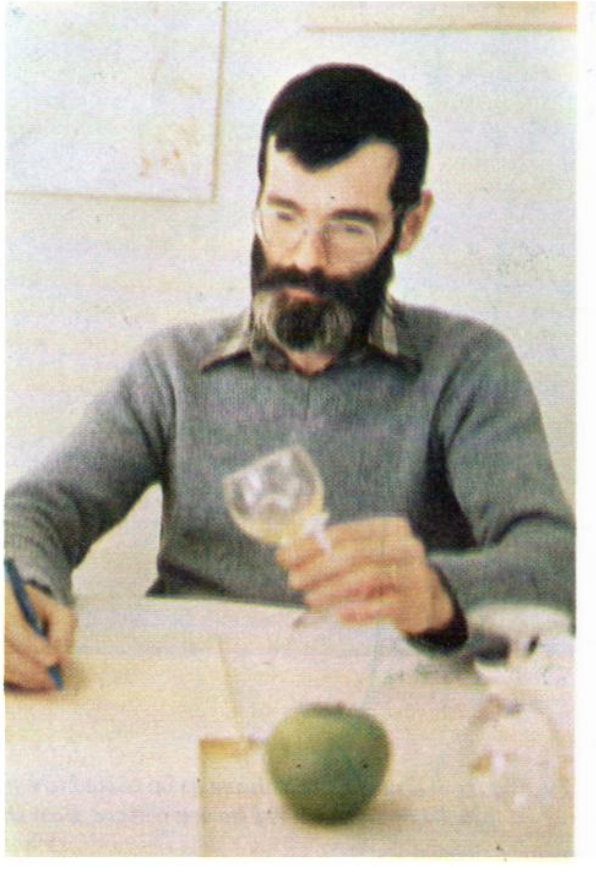
In general, *all the described exercises* and other that can be imagined as well, *must be done and repeated as often as possible.* They constitute an indispensable basis for learning how to do the tasting. The steady practicing of such tests allows for a refining of the sensorial perception and an improvement of the quality of the answers. Such exercises will be made in a more or less formal way with the help



IV. Fig. 3



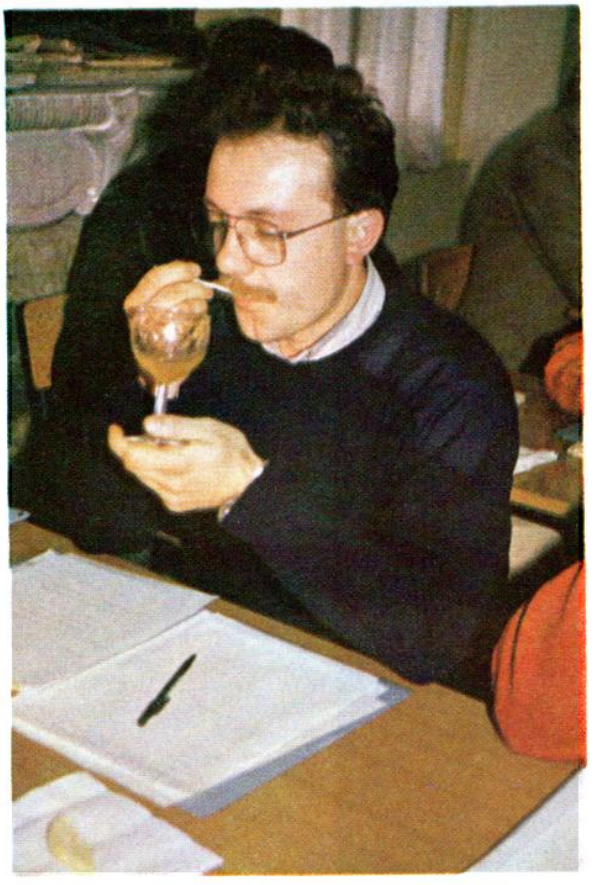
IV. Fig. 2, 3, 4, 5 — *Chronologically the product's appearance is appreciated (1); after honey was spread on a large surface one seizes the glass stem, raises it to the nostrils, breathes in long and rythmically (2). Then honey is tasted once or twice (3) and the appreciations are transcribed (4). (Photographs G. Vache and M. Gonnet).*



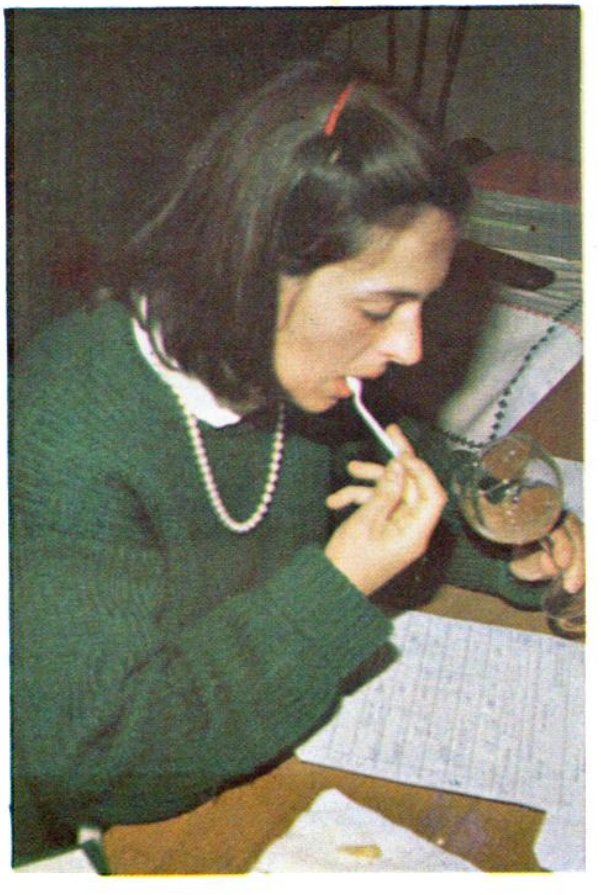
of honey samples recognized as typical and kept in a "collection". These samples that constitute the beekeeper's "meloteque" can be kept in a refrigerator or even in a freezer. Exchanges of pedagogical material of this type can be made between interested people in the neighbourhood or even from far away. County, regional and national beekeeping trade unions would be in this case excellent relays to support this promotional and educational activity.

The training courses organized by us can be at an elementary level, meant to make the beekeeper or the layman aware of the problems and teach the sensorial analysis of honeys. The proposed tests are simplified in this case. There are also training courses oriented for the already experienced people. In this case the tests are more numerous and difficult and during the tasting sessions they exercise an evaluation of their knowledge. Depending on the obtained results they will receive *a certificate of capacity* in tasting. Yet, this is only an experiment, but we believe it will arouse the interest of many people to practice and improve their ability in the field of honey tasting, that will finally lead to the formation of a group of qualified experts.

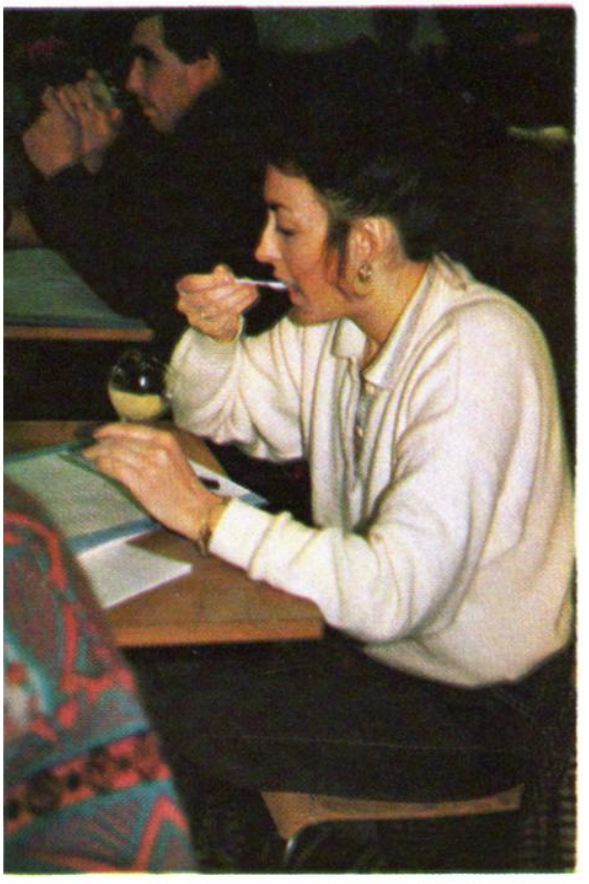
IV. Fig. 6 — *Samples that have to be tasted are put into a glass. Preparation of test of tactile appreciation; blocks of crystallized honey are cut with the knife for the crystalline texture to remain intact. (Photo M. Gonnet)*



IV. Fig. 7



IV. Fig. 8



IV. Fig. 7, 8, 9 — *Presentation of an evaluation of monofloral honeys (Photo A. Vanhees)*

IV. Fig. 10 — *Learning how to taste (Photo M. Gonnet)*

V. Study on Deficient Honeys

A) Crystallization Flaws

Flaws of honey crystallization are numerous resulting in quite varied inconveniences.

We can differentiate faults in *building the crystalline structure* and faults following some accidents of *post-crystallization.*

a) Faults in building the crystalline structure

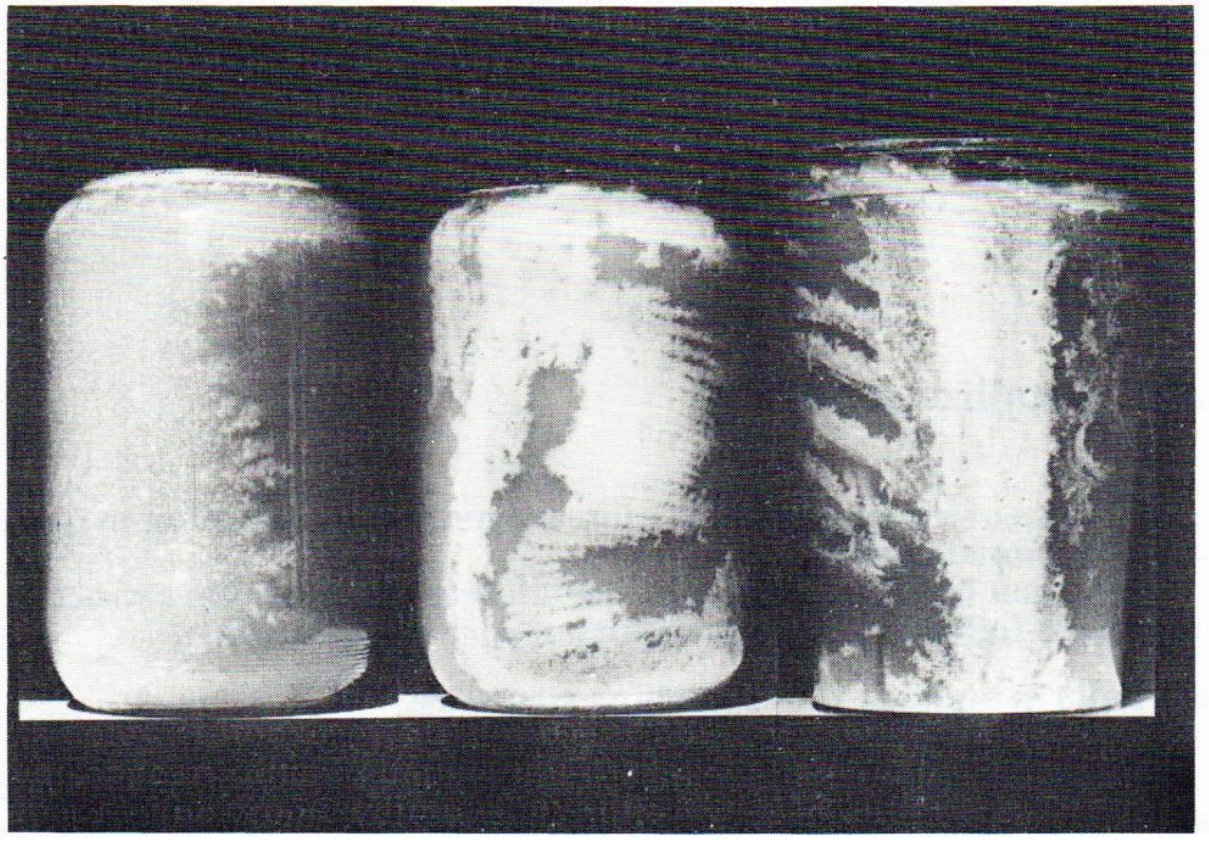
Honey crystallization can be incomplete. It is *the case of a very slow natural crystallization* after a faulty melting. In this case crystals that are formed aggregate, harden and tend to precipitate or to migrate towards the jar walls. The only remedy that can be applied is the perfect remelting of these honeys and reseeding them with the help of a strain with very fine natural crystallization.

Honey *crystallization* can be complete but with *a rough granulation.* The natural building of a crystalline structure of this type should be avoided as much as possible. The controlled crystallization practiced on liquid honey is the only recommended solution.

Despite a perfectly acceptable granulation especially after seeding, the natural crystalline structure of honey can become very firm and strongly cohesive. This solidification in rough mass involves difficulties when extracting it. We must admit that this fault, frequent enough in certain honeys, can hardly be avoided. We can succeed either by making mixtures to diminish the glucose/water ratio and sensibly increase the fructose content of honeys that have to be crystallized or equipping ourselves for the production of creamed honeys.

b) Post-crystallization accidents

However the most frequent accidents are observed in already crystallized honeys that change during conservation. The most spectacular and gravest accident is *texture collapse* when crystalline structure of honey precipitates towards the bottom of the jar and a liquid high in water floats above. There are no satisfactory solutions to undo this destruction of honey. When a honey has a high water



V. Fig. 1 — *There are three samples of honey that present defects without any consequence in the organoleptical or tactile fields, but which penalize the product in the visual field and reduce its commercial value*

content and crystallizes its crystalline texture is in general fragile and the product presents a high risk of separation of phases. In this case the liquid phase of honey will have to be preserved by using an adequate treatment, like pasteurization or controlled heating. It can also be mixed with another less humid honey, richer in glucose that will cause the hardening of the crystalline structure when it is formed. Honey that suffered a separation phase ferments very often starting from the liquid that floats above. The two separated layers of honey can no longer be linked even by stirring them. Honey can be remelted in case it did not ferment and can be mixed as mentioned above.

Less grave but very disturbing and more frequent are the small accidents of *post-crystallization* as *marbles* and white spots that appear on the walls or the jar surface. These phenomena are due either to air bubbles enclosed into the mass of honey that are released and break onto the jar walls or to genuine air pockets that form in contact with glass when, for instance, crystallized honey shrinks under the effect of sudden cooling. To avoid these shortcomings palliatives are often resorted to, as the use of an opaque jar or very wide labels that surround the jar and conceal all faults. In the technological field the most rational solution consists in preparation of honey with pasted

texture (creamed honey) which under certain precautions does not suffer this kind of incident. Honey packed in glass jars and presenting visual faults of post-crystallization can be slightly warmed (30°C) for 24 or 48 hours. Following this treatment, flaws tend to blur, contact is lessened but will never entirely disappear.

B) Dirty Honeys

We already dealt with this problem in the previous chapter. Before packing, honey has to be satisfactorily purified, either through decanting it for a number of days at about 30°C or by filtering it. The two operations can be practiced successively too. Afterwards honey will be conditioned and sold cleanly packed with a tight lid. Recipients should be rationally filled; however honey should never touch the lid. These elementary precautions allow avoiding the overflow of the product on the jar walls, as well as on the shelf, as it sometimes can be observed in stores.

"Pressed honeys" that are obtained by pressing combs full of honey, always contain impurities. The guarantee of the origin of these traditional products becoming very rare on the market normally undergoes a very coarse purification. These honeys are fragile and are very poorly stored.

C) Too Watery Honeys

They are unstable honeys: in a liquid stage they can ferment, in a crystallized stage texture collapse is feared. Pasteurization can guarantee a certain stability to these honeys avoiding on the one hand their fermentation and on the other ensuring their preservation in a liquid stage. The beekeeper who does not have access to this technology has to harvest his honey perfectly capped, therefore sufficiently concentrated by the bees. If however the harvest product is still rich in water a part of it, in excess, can be eliminated by superficial dehydration on the frames before extraction.

The high water content of honey is already observed at the level of its presentation, as we have already described it. The gustatory characters of a too watery honey can be sensibly modified related to the reference product with normal humidity. In general, these changes are perceived at the sensorial level in a negative sense. Honeys which have a high water content have in general a weaker aromatic strength and look diluted.

When tasted, the tactile appreciation is bad because it does not correspond to what is expected from honey in this field. They flow too much during extraction and their weak viscosity leads to a rapid ingestion that determines frustration to the taster. There is still a

V. Fig. 2, 3 — *Incomplete and rough crystallization. Construction of this granulation type takes place very slowly. It happens most often in previously heated honeys (Photo M. Gonnet)*

known exception to this scheme, it is regarding honeys foraged from heather *(Calluna vulgaris)*. At 17 or 18% water content they have a more or less marked bitter savour, but this bitterness disappears and they are in general better appreciated when their humidity amounts to 20—21%, a level considered as normal for this type of honey. Let us note however that these honeys have a different viscosity (thixotropy) and that they flow with difficulty even when their humidity reaches 22 or 23%. Humidity in honey can be very easily ascertained by using a refractometer produced for this purpose.

D) Fermented Honeys

The fermentation of honey can be pointed out by sensorial analysis using a visual examination of the product, as well as a gustatory test. The visual examination leads to the observation of foam upon honey; this foam is produced on the surface by a multitude of carbonic gas bubbles that are released from the product's mass. Carbonic gas bubbles are in general larger than air bubbles and they have a slightly silky appearance in the foam.
When it is finally obvious honey fermentation gives an efferves-

V. Fig. 4 — *Phase separation. The crystalline texture was too weak or became fragile and the edifice collapsed. The upper part enriched with water will degrade most quickly. (Photo M. Gonnet)*

cent aspect to the products as illustrated in figs. 5, 6. With some experience, the beginning of fermentation can be discovered by the olfactory way, by a slightly burning sensation at the level of the nasal fossa. This sensation is often accompanied by a more or less marked sour smell.

The aromatic characteristics of fermented honeys are different. These variations depend a lot on the nature of the ferments that have developed, as well as on the products of their metabolism. It happens that fermentation is increasing, accentuating, exacerbating the natural aroma of honeys, especially when this is "carried" by neutral alcohols formed in the medium. In this case, the lay taster can be deceived and can give positive appreciation such an unstable product from the biological point of view. But the taste of fermented honey is more or less disagreable, sometimes down right distasteful. This defective appreciation is even very persistent when the product is undergoing a degradation or only fleeting when fermentation is rapidly stopped but leaves an indelible aromatic trace. The complex and global olfacto-gustatory sensation given by these fermented honeys can be translated into a certain sourness, a more or less strongly felt acidulated taste. The gustatory test practiced on fermented honey also allows the tongue to perceive a slight acidulated savour, no matter what the aromatic quality of the degrading product.

In current tasting a start in honey fermentation is very often perceived, but identified rarely enough. Most often it is assimilated to a simple defective taste. The beekeeper and the taster who in the preparation stage of honeys is one and the same person, are totally interested to recognize this capital fault and the specific stimulations it provokes.

All fermented honeys cannot be retrieved. But honey at an incipient fermentation state immediately recognized and stopped can still be recovered without an excessive quality loss. Solutions to be kept in mind in order to avoid this drawback are especially of a preventive character. Honeys with a water content more than 18% can ferment if they meet favourable conditions (temperature ranging between 10 and 25° C, a large quantity of yeast contained in honey). Therefore, in order to avoid fermentation the following should be done:

— either to produce honeys with a water content less than 18% and preserved as such;

— or to stabilize through heating high risk honeys (pasteurization, bain-marie);

— or, finally, to keep fragile honeys in a cold room (at a temperature below 10° C).

But fermentation is an unpleasant biological degradation which the beekeeper cannot always master; it happens sometimes that some honeys begin to ferment in cells during their elaboration by the bee. Yet, most often, this phenomenon appears and develops after harvesting and in the moment of crystallization. Honey taken in this stage is

very unstable from the physical point of view, the forming crystals lose a part of their water to the benefit of the phase that remains liquid. Therefore, ferments will develop on this watery underlayer. Crystallization finally completed, active fermentation can cease, but the honey has already suffered a very perceptible sensorial deviation and in addition, enriched in yeast, the medium remains very unstable.

E) Warmed Honeys and Old Honeys

Excessive or prolonged heating of honey provokes its accelerated aging, so that we can present these two categories of products together, both likewise defficient. The sensorial analysis can help in recognizing these honeys, although most often the original reference is not memorized. Still when this reference is kept at a low temperature it can serve as such.

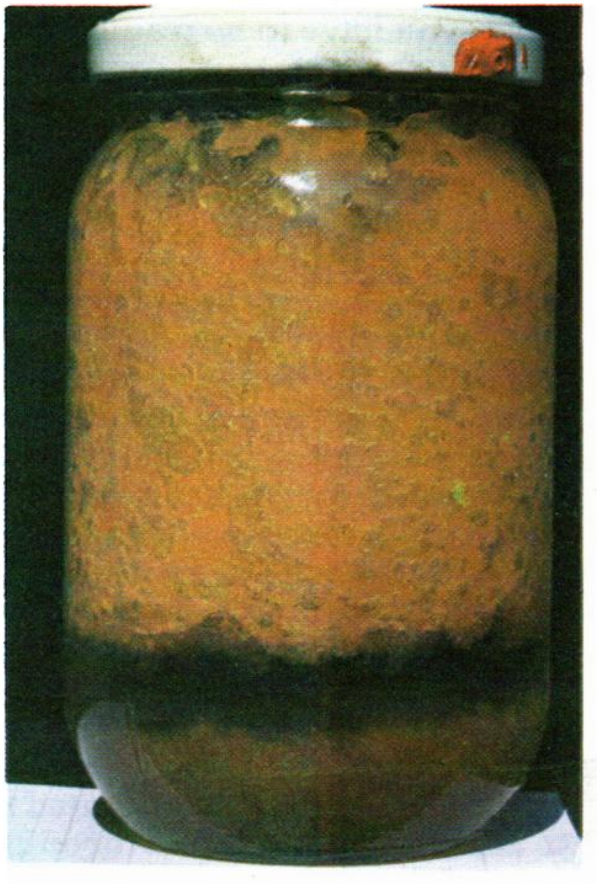
In general, when honey underwent changes following the heating effect, its colour intensifies, its natural aromas are modified, some tend to disappear, others change, but the strength and global aromatic fineness of the product diminishes quite a lot. The slight caramel smell and "taste" is perceived, more or less marked, according to the importance of the interfering changes. A very slight bitterness is then sensed that is going to increase with aging. This particular complex that we could qualify as "baked honey" is sometimes discreet; you have to be trained in order to recognize and remember it.

Honey suffering excessive heating or kept for too long at normal temperature is irrecoverable. When the fundamental chemical and biochemical changes occur, the phenomenon is irreversible; the legislator's duty is to fix the limit above which the product loses its commercial quality.

In order to preserve the essential original qualities in honey we have to supervise the storing temperature; this should not rise above 20°C. A temperature of 14°C is recommended; these are the best conditions for honey crystallization and it is a good storing temperature as well. A honey should be heated only when this operation proves to be necessary (decantation, remelting for packing) and the most appropriate way of heating will be chosen (heated environment (air), circulation of warm water, pasteurization).

For the sake of efficiency all heating systems with resistence, in which the product that undergoes heating is in a direct contact with the heating source, should better be avoided. In this case, either the adjustment is good and honey is getting warm very slowly, but the remelting takes a long time, or the adjustment is badly done and honey that is warmed too rapidly and too strongly will alter. Warmed honey disintegrates in an accelerated manner as temperature rises. Fructose is partially destroyed through molecular dehydration.

V. Fig. 5, 6 — *Declared fermentation in a lavender honey (down left) and in a heath honey (down right). Carbonic gas bubbles are released and migrate towards the walls and the lower part of the jar. (Photo M. Gonnet).*



Hydroximethylfurfural is formed, followed by bitter substances of the melanoidine type. Above 85°C this decomposition is considerably speeded up.

F) Honeys with Bad Taste Induced by Substances Foreign to the Natural Product

To say about a food that it has "a bad taste" does not compulsorily mean finding fault with it, this appreciation being subjective. What honey is concerned, for instance, it will have to make the difference between aroma and natural flavour and tastes and foreign aromas. Certain chestnut or arbatus honeys have a more or less bitter flavour that can be considered very agreeable or repulsive. We deal here with the accidental "bad taste".

Honey can suffer different pollution that is liable to alter its taste. *Bees and beekeepers can be at the origin of these alterations,* before, during and after harvesting.

The bee can elaborate a deficient honey through foraging sweet products mixed with different chemical substances, with industrial food, or for agricultural purposes (spillage from plants, spraying products as fertilizers, waste material from sweets factories, etc) or simply by stocking degraded feeding sugars. In general, fertilizers, insecticides or other dangerous substances are not found in honey. In order to finish their return flight to the hive, bees consume a part of the foraged nectar. Very often they die during this flight when the harvest is poisoned. Denaturants classically used are not very dangerous products, but mixed with honey they basically modify its colour (iron oxides) or taste (bitter flavour produced by octosan). To avoid these, always annoying accidents, precautions have to be taken about the foraging zone or perfectly rationed feeding with denaturated sugars has to be practiced.

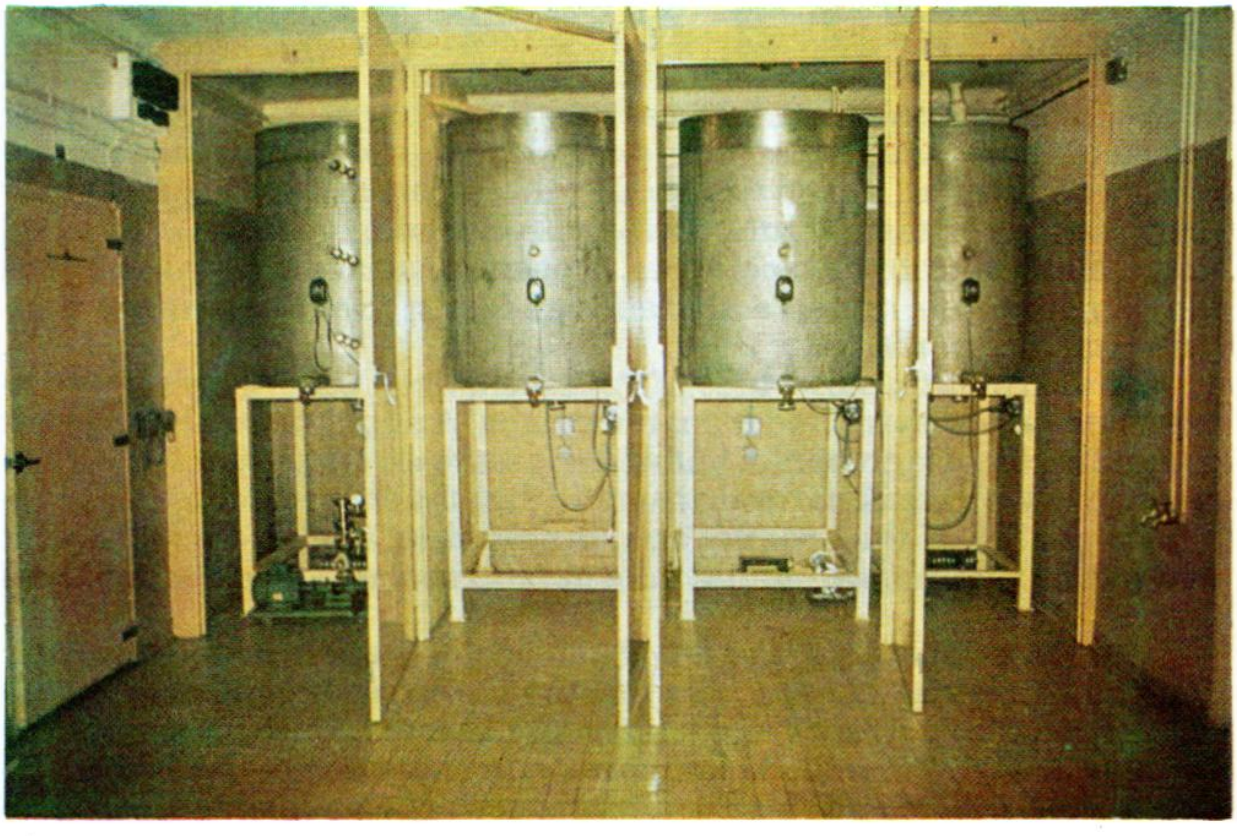
The aromatic molecules of "old melanized wax" very easily impregnate honey extracted from old combs. A slight taste of wax is not compulsorily disagreeable, but when it is too strong, especially in honey with a very weak natural aromatic threshold, it can change the intrinsic quality of the product and, in this case, it is an obvious fault. From time to time, we should take care to replace old dark coloured combs.

Certain *illnesses of the brood* can accidentaly transmit parasitic smells and aroma to honey. For instance, *American foul brood* is quoted. Brood that suffers from bacterian illnesses, releases a typically "pungent smell" when it decomposes especially due to the accumulation of valeric acid and sulphuric hydrogen. These smells spread rapidly into the stock. Fungical diseases with *perycistis, apis* or *alvei* (mycoses) can generate different intense aromas in the hive (smells and aroma of fresh yeast) that honey is susceptible to incorporate. Colo-

nies with illness should receive rapidly an adequate treatment and it is preferable not to use honey harvested from these colonies.

Among different foreign aromas and tastes with which a perfectly elaborated honey can be impregnated we quote: *smoke*, often used for harvesting or inspection of hives; *chemical products* that chase bees during foraging; different toxic substances that serve for wax protection, or *paints* and *wood preservatives* used to treat the wood of hives.

Smoke rapidly impregnates honey. If the taster is not a smoker he will discover it from the very beginning, by smell. In a larger dose, smoke can give honeys a burning taste or more precisely a pungent *taste after swallowing it*, when it is marked, irritates the mucous membrane down the throat. This accidental, sometimes discreet, but always undesirable defect is more frequent than it is believed. It can be found especially in honeys produced by beekeepers who use traditional harvesting techniques. To note that honeys reputed to be "neutral", like acacia or alfalfa, for instance, are more fragile because they do not have a natural aromatic cover at a sufficiently high level. An external, even slight, pollution is susceptible to mark them for ever. Consequently, smoke has to be used in small doses. It is useless to "suffocate" bees, because, except for the disturbance smoke pro-



V. Fig. 7 — *Decantation basins used for honey. These receptacles are made of stainless steel. Aluminium can also be used, as well as any alloy or plastic material with a food label. (Photo M. Gonnet)*

vokes in the hive, we also risk a very sensible depreciation of the honey. Let us also add that it is advisable not to burn all kinds of things in the smoker. The heavy and burning smoke of old jute sacks should be avoided. Preferably dried vegetal waste, as that of pine needles or lavender hay should be chosen.

All *chemical repulsives* have to be cautiously used. To take the frames out of the hive a few drops of a concentrated product with good commercial purity, that will imbibe a sack cloth, will be sufficient to rapidly chase the bees towards the brood chamber. These substances are in general poisons with phenolic or benzenic nuclei. No direct contact between these products and hives that contain honey will ever be tolerated. Honey which would smell of phenol or with benzaldehyde aroma (bitter almond) would be dangerous and irrecoverable.

Finally, we have to take care to correctly ventilate the combs that were treated against wax moth. A nectar stored too quickly in cells still impregnated with sulphuric anhydride or worse still *with toxic volatile substances* (of the methyl derivates type) that are often used for this type of treatment would become an uneatable honey. Hive bodies and frames covered on the surface with paint or with other products that serve to *protect it and as wood lining* have to be perfectly ventilated and satisfactorily dried before use. We should avoid especially the covering with *carbonyl* whose very persistent and unpleasant smell can impregnate the honey.

As a general rule, all above-mentioned chemical substances are reputed to be more or less dangerous to be manipulated and breathed in. There is legislation in this field and it is good to always relate to it.

The taste of honey can be rapidly modified if we do not take a few elementary precautions at extraction, storing and packing. For instance, honey will never be put into vats that already served for storing aromatic substances (oils, essences etc). The bee's product should not be left too long in combs, barrels or open honey tanks in a place where volatile chemical products, such as fertilizers, insecticides etc. are stored. If honey is stored in metallic vessels these should compulsorily correspond to the food standards in force. Paint used for the inner cover of barrels that serve for transportation or storing of honeys should carry the "food label". Honey is an acid product; it reacts in contact with certain metals, especially iron, copper and zinc. Oxides are formed that will denaturate the food modifying its chemical composition and taste. In general, places where honey is extracted, stored and packed have to be clean, dry and acceptably ventilated. Honey is a natural product, it should never be sterilized, therefore any accidental soiling is susceptible to degrade it. Let us finally examine a few precautions that should be taken when choosing the packing for a detailed conditioning. Preferably the choice should be glass, inodorous food plastic, stainless metal or metallic packing covered with a plastic coating. The metal bucket coated with tin that is

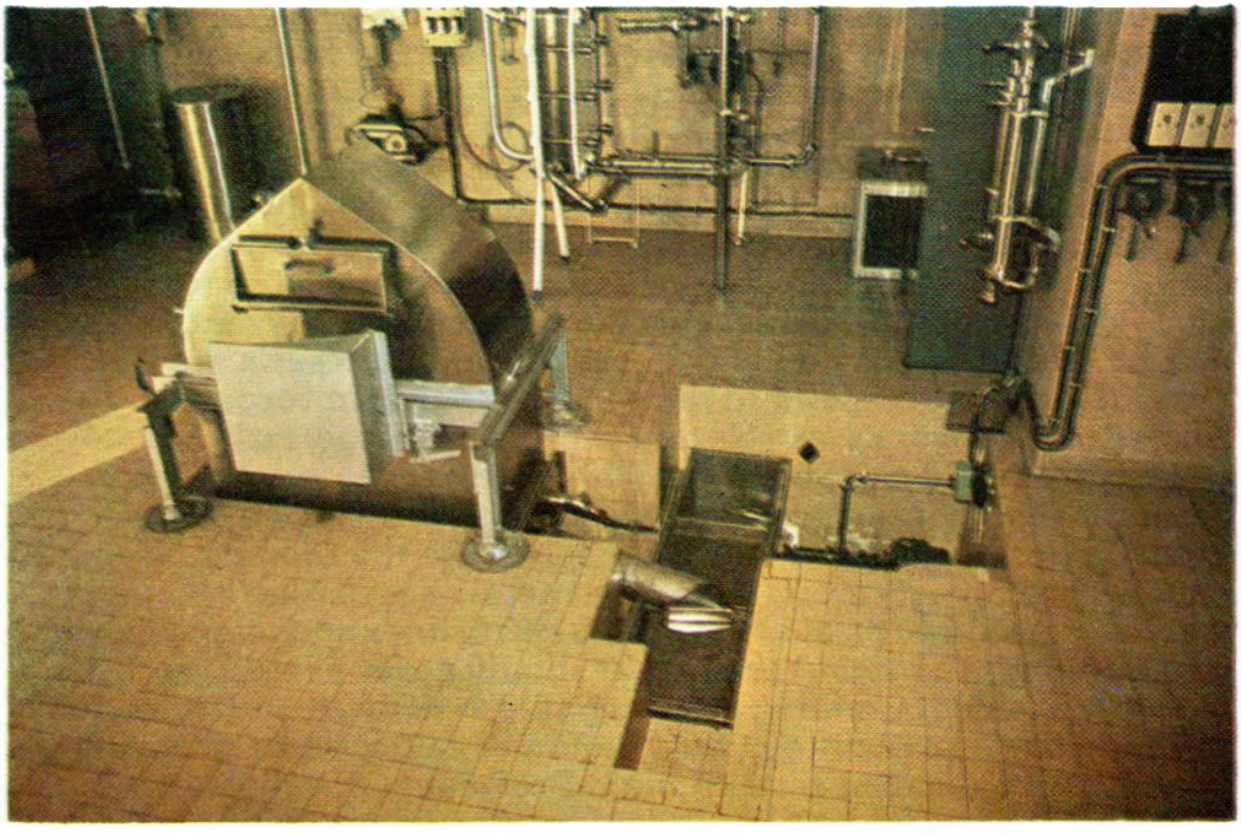
still used frequently to store or to present honey is not be recommended especially for long preservation that goes beyond 2—3 months. In time, honey reacts with the metallic complex and derivatives from this oxidation diffuse into honey. Cardboard should also be avoided, though a traditional packing for honey; these receptacles are not sufficiently tight and humidity bearing eventually the environmental "smells" can penetrate and denaturate honey. All receptacles that serve for honey's conditioning should be perfectly clean and dust proof.

Finally, remember that honey degradation of biological (fermentation) or thermic origin, following heating or natural aging, provoke formation of different substances (acid or caramel). These faults were described in the previous paragraph.

G) Appreciation Tests of Defficient Honeys

The study of honeys with a faulty taste is reinforced during practical working meetings where the participants will strive to recognize and memorize some of these faults, considered the most frequent.

Honey diluted to 21% water (legal limit accepted in the European Community) is compared to the gustatory and tactile appreciation level of its reference with a normal water content (17—18%).



V. Fig. 8 — *Storehouse of experimental honey of the Beekeeping Station at I.N.R.A. in Avignon. "The honey storehouses should be clean, dry and acceptably ventilated". (Photo M. Gonnet)*

Some honeys that underwent natural fermentation are offered for experimental tasting. This test allows one to appreciate the important qualitative differencies that exist between these products at olfactory, as much as gustatory level, and this according to the nature of the developing ferments. This is an indispensable test to easily recognize and memorize a basic defect.

Gustatory tests are also practiced with products highly heated. A batch of honey is divided into a lot of portions. Each of them is brought to a high temperature, ranging between 50 and 80°C. The necessary required time to reach these temperatures (exposed in thermostatic drying closet at 85°C) vary between 2 and 48 hours. Each of these samples are then tasted in a progressive order depending on the intensity and duration of practiced heating. We have an interesting reference scale: this is the quantity of hydroximethyl furfural measured in each of these honeys. Every taster can thus become accustomed to the typical smells and aromas coming from warmed honeys, defining at the same time its own recognition limit of the perceived defect.

Finally, samples of honey that were impregnated with volatile substances deriving smoke of different origins are submitted to tasting. These defficient products are prepared setting out from slightly aromatic honey that is left in a bucket in a closed space and in a thin layer. The atmosphere is matured with smoke of different origins produced by a beekeeper's smoker. These types of smoke can be of different qualities according to the nature of the fuel burnt in the apparatus. Smell, aroma, as well as taste after eating, sensed as choking, are typical and easy to memorize. The perceived sensations are in general qualified as unpleasant, but with different appreciation grades. However, inveterate smokers consider them bearable.

Obviously nobody is excessively eager to taste all these honeys that most often are destroyed by degrading or, are merely unpleasant to eat. However, these tests are very important and have to be repeated. To discover very quickly the poor quality of honey represents a capital and indispensable exercise. We have noted, for instance, that many beekeepers or apprentice tasters do not recognize the beginning of fermentation in honey. Worse, the characteristic "fermented honey" is well registered, but it is assimilated with a natural taste. And such a product is unstable and the anomaly has to be very quickly discovered to try to cure it or, at least, to avoid trading the degraded product. The same observation can be made for too old honeys or too heated ones that suffered important damage, and for this reason have to be legally eliminated. First the intensity, as well as quality of smells and natural aroma of these honeys diminish and an aroma or caramel type is slowly substitued. The latter can be discovered and identified when the HMF content reaches an average of 15—20 mg per kg of honey.

VI. Investigation and Exploitation Methods of Various Systems of Notation and Classification of Honeys by Sensorial Means

A) Quality Evaluation

An alimentary product should be evaluated on the basis of a given number of successive criteria, each one of these being more or less selective, but when finally regarded as a whole one should be able to qualify or remove the product. We have to admit that such evaluating means, even though it is logical, it is not always considered a rule; on the contrary, some time ago there used to be a certain "vogue" leading the selections towards the standardization of agricultural products. Broadly speaking, the appearance of aliments (especially fruits and vegetables) was judged by a very high quality index; since this characteristic was the easiest for an objective evaluation, among all, "the nice product" had a great advantage: it instantaneously aroused "eyes' pleasure", consequently the appetite, and was followed by the purchasing reflex of the buyer (consumer). It frequently happend that once it was tasted the deception occurred. Obviously, this annoying practice caused many excesses, reason for which nowadays a certain balance of all organoleptical criteria gain an increasing significance.

For a more efficient protection of the consumer, it is desirable to apply the method used for the qualitative evaluation of wines, meaning that quality approval should have in view two successive points:

— *a laboratory analysis* — first of all, which will establish the product's state in relation to the admitted norms and the legislation in use, and then:

— *a sensorial analysis* — more or less detailed, which will allow to define the organoleptical quality and the origin of the respective product.

All currently used products, either natural or transformed, could be submitted to this double evaluation. Such a practice aims to offer the consumer those products which have all the desired quality requirements and hygienic guarantees. At the same time it must sa-

tisfy the consumer as to the taste, to give the organoleptical pleasure and emotion. It's not enough to have a product deprived of faults to attain the perfection from a qualitative point of view; quality also means sensorial pleasure and satisfaction.

Such kind of sensorial research could be currently applied in various stages of the trade market. First, the producer himself should make it directly at the source and then at the buying station; finally, by consumers' associations, and why not even by official services of quality control, where this practice, viable as it is considered, is most frequently ignored. To this point it should be better to proceed in making technical descriptive and convergent sensorial analyses and not only a succession of haedonical, simple, individual and little exploited ones. This aspect requires highly competent tasters required to make the analysis, complying with a stict moral discipline, knowledge of a certain mostly used speciality vocabulary, and a clear wish to obtain concrete results in this experimental field.

B) Classification and the Nature of Honeys; Different Evaluating Methods

During a competition with a jury to qualify the honeys, all the references obtained are translated by tasters into general classification indexes; usually these are translated into notations. As a tradition, in all the competitions for local or regional sorts of honey these notations as well as the classifications deriving from them are made within the group itself, out of which results:

— frequent oral exchanges, generating suggestions; the most convincing taster tries to rally the members of the jury to his opinion;

— confusion and absence of mind leading to less exact results;

— noise and entertainment are less favourable for a fruitful concentration.

Within the new framework we suggest, each taster who is a member of the jury, should *individually judge,* considering only his own knowledge. Therefore, he should be provided with a personal working sheet of paper and an evaluation code previously defined.

The total sensorial analysis of a sort of honey may be done in various ways. For example, in order to accomplish a *descriptive analysis* one should have first of all a working diagram. The *individual card,* as presented in *Table 1,* could be very useful to the uninitiated taster, giving him the possibility to practice, then describing as accurately as possible the unifloral and polyfloral honeys on which he will further work. *Card no. 2* is simplier and more concentrated. It is used in observing a greater number of samples and it is better adapted to the method of the expert taster who is able to quickly synthesize his own

analysis. However, both the cases presented above need to have a *proper well-adapted vocabulary, a good, complete and most precise catalogue.* In annex no. 3 we suggest a scheme of this vocabulary which should be completed and improved.

Final notations, which are to be adopted, should be previously strategically chosen and conventionally perfected.

Cardinal marks, from 0 to 10, from 0 to 20 or any other numerical index, enlisted in a conventional value (period), are still frequently used. However, their standardization is very hard to be perfected and the notation differences, from one taster to another, could be very great. Although, it is possible to adopt an evaluation system which may lead to limiting the amplitudes. It is (most frequently) in use so as to give superevaluation indexes to sensorial parameters considered as the most important ones. Adjusting and final arithmetical averages, resulted from these calculations offer an illusive explanation which doesn't necessarily give the most precise quality.

According to our opinion, in order to allow for a rational interpretation of results, the notation should be done according to a precise and constant method of separation, identification and measure-

Table 1

Descriptive Notation Card of a Sort of Honey

— Date of tasting:	— Name of the taster:
— Place:	— Honey origin and sample number

I. *Visual Sensations*
- — Colour
- — Fluidity
- — Cleanliness

II. *Olfactive Sensations*
- — Smell intensity
- — Identification
- — Possible faults

III. *Gustative Sensations*
- — Flavour intensity
- — Identification
- — Persistency
- — Strict sapidity
- — Usual chemical sensations
- — Possible faults

IV. *Tactile Sensations*
- — Mass solidity and unctuosity
- — Granulation (crystals' thickness and shape)

V. *Whole Aspect* (Evaluation)
- — Conservation state
- — Honey's level in its category
- — Mark (ordinal or cardinal, depending on the approved convention)
- — Clearness
- — Homogeneity
- — Crystallization

ment. Thus, for a higher objectivity, we suggest the use of a *reference dial* established in *ordinal values*, gradations of which show inferiori-

Table 2

Honeys Notation Cards

— Date:
— Place:
— Taster:

Origin and sample number	Synthesis annotations on perceived sensations and (eventually) partial marks with differentiated indexes or without indexes				Evaluation on whole and final mark
	Visual sensations	Olfactive sensations	Gustative sensations	Tactile sensations	

ty and superiority rapports without intrinsical mathematical value. Figures or expressions may be memorized in dials having 3, 5 or 7 levels, as the below given examples:

	1 most superior	1 most superior
1 superior		2 superior
	2 superior	3 satisfying
	3 limit	4 limit
2 limit	4 inferior	5 moderate
		6 inferior
3 inferior	5 most inferior	7 most inferior

We have used for honey the *dial with seven levels* (heptarus), which offers the greatest number of expression possibilities, taking into consideration honey's potential heterogeneity.

The Notation Card perfected by the Institute of Origin Denominations (Institut National des Appellations d'Origine — INAC) was adapted for honey (table 1) and consists of:

— identification coordinates: date, place, name, numbers;
— marks and terms pointing to the quality of the product;
— a code to evaluate the intensity of faults;
— seven columns which stipulate:
  — number of the anonimous sample;
  — possible mention on four columns of the observed faults in the visual, olfactive, gustative and tactile sensations. In this view, the number of crosses is encircled corresponding to the level of the perceived intensity, that is:
    — a cross for a minor fault;
    — two crosses for quite a strong fault;
    — three crosses for a really strong fault;

— identification of significant qualities and faults, where the analyst (briefly) points the main characteristics noticed;

— the ordinal mark corresponding to the heptar dial.

This type of card requires a minimum writing; it is simple, polyvalent and accurate. At the same time it is the most suitable for making a simple sensorial analysis of differentiation and a more complex evaluating analysis. Individually, it allows for the objective evaluation of the product as well as of the competence of the analists, who, provided that they are good tasters and have deeply understood the system, must give homogenous appreciations. Card interpretation should have previously been the object of conventional determinations of eliminatory criteria of acceptability and classification.

Table 3

Honey Notation Card

Tasting Date . . . . . .
Tasting Place . . . . . Commission No. . . . . .
Taster's Name . . . . . .

Ordinal Notation Dial
1. Most superior
2. Superior
3. Satisfying
4. Limit
5. Moderate
6. Inferior
7. Most inferior

Faults Dial
x=minor xx=quite strong xxx=very strong
(encircle the number of crosses corresponding to the noticed intensity level)

Sample No.	FAULTS				Appreciation significant qualities and faults	Ordinal mark
	Visual	Olfactive	Gustative	Tactile		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		
	xxx	xxx	xxx	xxx		

In annex 3 we have already appreciated these terms. The reader will find the recapitulative table followed by an interpretation card, in which we suggest the use of a simple and elementary vocabulary, in order to specify, to classify and evaluate the importance of faults and honey qualities. We finally consider that this ordinal card repre-

sents a good synthesis of description diagrams, more pedagogically, as table 1 and 2 illustrate.

Different *systems of data exploitation* could be used; the one we have applied is the classification on position criterion. The reference mark of a honey will be the sum of the classifications made by the different members of the jury. Thus, if a honey is evaluated by five persons who have given for three times consecutively the position no. 2, and for twice the position no. 3, the final mark is going to be three multiplied by two, plus two multiplied by three, which makes 12. Having been given such conditions, the best honey belonging to its category will be the one which has obtained the smallest value. This practical system is given in table 4, under the title "Recapitulative Card of the Jury". In this respect, in order to illustrate this example we have chosen a batch of honeys, references of which indicate "lavender" and which have been submitted to the sensorial test during a course. Notice should be made here that out of 10 analysed honeys, two which didn't show the floral characteristics of lavender were eliminated, the rest been classified depending on the above described calculations. The ex-aequo-us classification is obtained through the method of "squares", as presented in the bottom of the table.

However, according to our opinion, in a competition it is preferable to: either classify the produced ex-aequo which amount the same number of points, or divide them as a result of expert talks, after having made another tasting.

In order to give a quality label one may use the evaluation method we have already described. In such a case, all honeys that have obtained mark 1, 2, 3 are admitted for label and all honeys on 5th, 6th or 7th places are rejected. As regards the samples evaluated in the

Table 4

Recapitulative Card of the Jury

Honey's Category: Lavender — Number of jury's members: 5
Jury No. 3

No. of samples	No. of repetitions of individual marks							Total of positions	Classification
	1	2	3	4	5	6	7		
401	I	IIIII						9	5
402	IIIII							5	1
403		II	III					13	7
404			I	II	II			eliminated	
405	II	III						8	3
406	III	II						7	3
407	III	II						12	6
408	II	II	I					9	4
409				II	II	I		eliminated	
410		II		II	I			14	8

Note: If ex-aequo, the square no. 401 should be done:

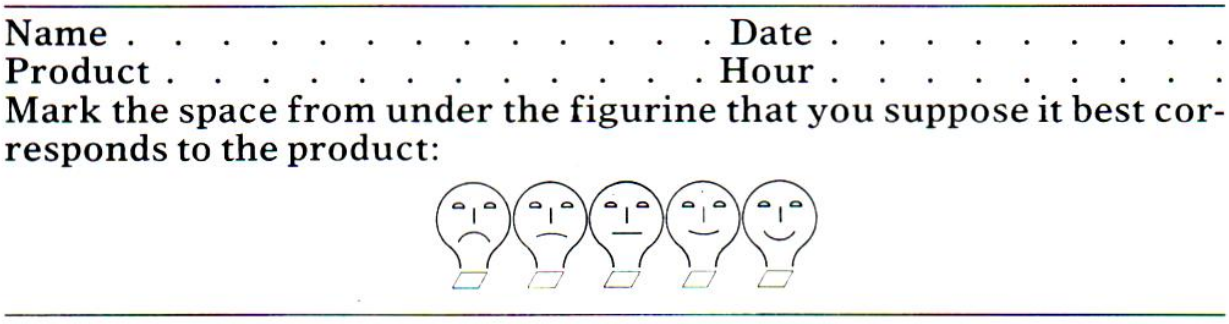
	1x1=1	4x4=16	17	5th
no. 408: 2x2=4	2x2=4	1x1=1	9	4th

4th position, these are to be discussed further on. Their disqualification will be given if the majority of the jury members has given honey a 4 or a bigger mark (5 or 6 for example), but, if contrary, this is to be discussed.

In the aenological field there are other types of notation cards, which may be applied to simple differentiation analyses, to more complex ones of appreciation, or to systems of hedonic notation.

Among the simple cards that may help for a first selection of the samples, without having any pretention for an intrinsical judgement, let's quote the original "*method of facial hedonistic appreciation*" (fig. 1). The taster makes a complete evaluation of the sample which leads him, rather quickly though, to an unexplicit choice of the type: delude, neutral or satisfactory product.

There are also other methods which give references, being more or less specific, and these help in evaluation classifying honeys by sensorial means. We shall quote three of these, applied in Italy, Spain and the Federal Republic of Germany.



VI. Fig. 1 — *Hedonic appreciation card. The space which corresponds to the satisfaction degree aroused by the product is marked.*

The members of the association "*Assaggiatori di miele*" (Honey Tasters) from the Italian provinces Friuli and Veneto have perfected a working card which shall be presented in table 5. The type of notation they have adopted is the following one: an ordinary dial with 6 levels and a whole of standardized marks in cardinal value, for the evaluation of each parameter retained in the visual, olfactive and gustative field. This notation practice was already experimented in the sensorial analysis of wines. As a matter of fact, according to our opinion, the notation card proposed to help in appreciating the product, enlists too many terms specific to oenology, a fact which represents one of the method's weak points. It is true that typical characteristic in wines such as: tonality, frankness, persistency, harmony are hardly present in honeys, and anyhow, the evaluation made on each of these features will not have the same significance for those two products. Consequently, and without a precise standardization of the vocabulary to the type and the quality of the perceived sensations, the mark given for qualifying a sort of honey by means of parameters in discus-

sion will be deprived of rigour. Let's add that this individual card is meant only for one sample, a fact which, in a competition, will require plenty of paper sheets and will complicate the results interpretation. Finally, we may talk about the problem of crystallization: its quality or intrinsical imperfections are not especially taken into consideration in this respect. Naturally, the final mark is going to be more precise than the one deriving from the ordinal classical dial, suggested by us. This happens because the total of the maximum of points given reaches one hundred. However, we may very seriously doubt the viability of the method as well as the reproductibility of the results.

The *Spaniards* too have made an *evaluation attempt in figures* of the quality of one sort of honey (table 6). They have chosen a cardinal notation card, giving each visual, olfactive and gustative parameter a different index, depending on the importance granted to the quality of the perceived sensation. The honey sample subjected to tasting may be eliminated, without notation, if it represents significant faults, or if it will not be judged at the value of 3 points in each of the five columns, placed under "partial mark" and if the evaluated quality was normally recognized, good or excellent. Then each obtained partial mark will be multiplied, with different indexes, and the sum of all these notations represents the total of points given to the sample. The attempt is interesting and may undoubtedly be a source of inspiration, if a more balanced grid than the one proposed will be used. The main weak point of the method, as it is described, lies in the intangible and arbitrary choice of the value given to each coefficient of multiplication. If we are content to retain from a honey having quality only the samples with a total of points higher than the mean, there will be some results to surprise us. It is true, there has been no equilibrium, except the mathematical one, proposed among the analysed parameters. One does not make a general view evaluation but it all refers to a simple arithmetical addition of more marks and does not search the harmonisation. On the whole, this method is much too arbitrary and does not leave many initiatives to the taster who cannot make variations on his appreciation.

The working card DIB (Deutcher Imkerbund), established and used by the beekeepers from the Federal Republic of Germany is very special. It is a reference card for judging the quality of the presented honeys for the national label. It is sometimes used also to evaluate the honeys presented in a competition. The method is original because the taster does evaluate the sample only on the basis of objective and perfectly codified characteristics; no personal initiative and no valuable judgement is required. In practice, he will carry out the analysis according to the information he gathers from a given catalogue made up of seven columns. (Honey presentation, cleanliness, physical state, smell, aroma, water content, HMF content). Each of the columns indicate the criteria of the reference quality, and then the

faults mentioned in progressive intensity. A cardinal mark is then given, enlisted into a period the value range of which is more or less wide, depending on the importance given to the analysed character (between 0 and 60 and on stages of 10 for cleanliness and only between 5 and 0 for smell and flavour, which are evaluated only by two simple criteria: the honey corresponds or not to the denomination. The maximum sum of the seven partial marks makes a total of 200 points. The most important coefficients (140 points) are given to the criteria of appearance. However, one zero may easily cause the disqualification of a honey, in all the cases, irrespective of the total of points obtained elsewhere.

According to our opinion and contrary to other exposed methods, this latter analysis doesn't start from genuine sensorial appreciation. It's rather a simple visual examination, showing in detail all the faults and which may be filled using the terms of an elementary chemical analysis. As regards the competence of one making such an analysis, as a taster he is very little entailed. He must only know the control sample to which the comparison will be made with the samples presented to him to say, without nuances, if these correspond or not to the reference. He should not make valuable appreciations on the gustative and intrinsical quality of the products.

The sensorial analysis is a very special field of investigation, and for its practice, the use of some completely objective methods cannot be rationally conceived. The reverse side too is deprived of seriousness and credibility, namely, the taster should be let alone to make a personal evaluation over an alimentary product, without previously having received the framework, and make him define by himself the main parameters upon which he will judge. However, the exercise is quite difficult and that's why we do not pretend to having completely succeeded in finding a solution. We have shown several methods of various inspirations; they all share in common the fact that they have been purposely described for the evaluation of honey quality. In this respect, rules were defined, systems of notation were established to finally reach a classification. However, in the current practice of tasting, there are undoubtedly other technics for the sensorial evaluation. However, there are no methods actually based on a registered basis, but on the experience of some people. Thus, they become more and more difficult to be concretized; moreover, the analyses deriving from them are not reproductible, therefore less credible. Among the described methods we may chose those that correspond the best to an achieved experience and individual sensitivities of the people required to use such techniques, and to vocabulary and expression affinities. The reflection sources are not the same for all, the judgements and the main criteria of the selection can be easily different depending on the cultural and sociological origins of each nation. However, a minimum of consensual bases is necessary; it may refer to a technical catalogue of data and to the selection of a harmonized vocabulary, re-

sulting from the same semantic source.

In the sensorial analysis, the training of expert tasters and the learning of adapted methodology are the two main conditions of the success. The evaluation method on the quality should be simple, clearly expressed and if possible it should avoid the most sophisticated notation systems which finally lead to the addition of very big points. The homogenous reproductible results, which are enlisted on small numerical intervals are the most highly used ones. Still, the taster should also have the possibility to add to his judgement the traditional knowledge on consumers' preferences, whose representative he is. Out of those several technical attempts we have described the ordinal classification method, which we consider to be the one giving the best possibilities of expression, yet without becoming rigid. The research carried out on this level did not aim at precision, but allowed

Table 5

ITALIAN CARD

A.N.A.M. Honey tasters national association

Sensorial analysis of the honey extracted through pressing 100/100

Sample No. Monofloral From Polyfloral

Tasting aim

Tasting Site

Produced in the town Region

Crystallization visual examination	Fine crystalls								Temp. of the env.
	Medium crystalls								Tasting hour
	Big crystalls								Date
	Creamy								H_2O /100
	Granulated								Year
	Compact								In conf. with
Visual examination	Homogeneity								
	Clearness	7	6	5	3.5	2.5	1		Notes
	Colour	7	6	5	3.5	2.5	1		
	Tonality	4	3.5	3	2	1.5	1		
	Fluidity	4	3.5	3	2	1.5	1		
Olfactive examination	Ingenuoussness	8	7	6	4.5	3	1		Notes
	Intensity	8	7	6	4.5	3	1		
	Persistency	8	7	6	4.5	3	1		
	Quality	8	7	6	4.5	3	1		
Gustative and retro-gustative examination	Ingenuousness	8	7	6	4.5	3	1		Notes
	Harmony	8	7	6	4.5	3	1		
	Persistency	8	7	6	4.5	3	1		
	Gustative and olfactive sensations	8	7	6	4.5	3	1		
	Quality	8	7	6	4.5	3	1		
	Evolutive state	6	5	4	3	2	1		

Commission No. Total score Taster

to take into account all the elements of the objective evaluation and to integrate in it a judgement with a more emotional but limited character. The rational equilibrium of these different parameters should be realized by this "man of art" who is the taster, trained and competent.

Table 6

SPANISH CARD

HONEY TASTING CARD

Sample No. _____ Type liquid, transparent _____
opaque _____
granulated _____

SCORE

	Partial	Coefficient	Total
ASPECT Fluidity (stickiness, humidity)			
ASPECT Colour			
SMELL (intensity, quality,)			
TASTE (intensity, quality, persistancy)			
TACTILE (crystalls dimensions, creamy)			
		TOTAL POINTS	

OBSERVATIONS:
ASPECT: dirty, with vegetal, insect and wax residues; vessel: excessively full, greasy, separation of liquid and crystallized phases; excessive fluidity; unhomogenuous, marble like; scum on surface; others _____
SMELL: unpleasant, fermented; others _____
TASTE: unpleasant, fermented, caramelized; others _____
TACTILE: _____
Underline the qualities you have perceived or add them if not mentioned above.
TASTER _____ DATE _____ SIGNATURE _____

VII. Promotion of Honeys

Usually, laboratory examinations are carried out so as to guarantee both the origin and the quality of honey. However, irrespective of the importance of the practiced analyses, a point to be discussed later, they bring neither serious information afferent to the possible pleasure of the consumer who will taste the honey, or on the qualities of the sensations which this product gives. Through the sensorial analysis one tries to put this sensation in terms of class, order, category, all this done with the greatest possible objectivity. Therefore, if we want to emphasize on the quality of honey, we must necessarily combine these two types of examinations, to permanently balance the objective laboratory results with criteria of sensorial identification as well as with the evaluation made by expert tasters.

Let's see which are the terms used for qualifying a honey at present. The quality of the bees' product may be determined on various levels through a whole lot of codifiable criteria. Thus, we define a *total appelation of "honey"*, with minimal limits, under which the product losses its denomination and the alimentary label. The present Legislation in the European Community, shown in Annex 1, is the same for everybody. However, the strict observance of this norm is not a high-quality warranty for honey. On the other hand, notice should be made that explicit references to the sensorial analysis listed in these documents are scarce and very vague. There are only some physical, chemical, biological and pollenical analyses which give references. The results obtained aim to guarantee the product's origin (vegetal sugars collected by bees) and to discover any possible faults.

It is possible, and at the same time desirable, that all quality criteria for a sort of honey should be further studied. This can be done using products of *commercial denomination,* references of which present them as being *monofloral* or regional and polyfloral and different and also through the selection of these honeys in *competitions* or by obtaining labels. However, such systems are already in practice, but in this field the essential is a job to be done from now on.

A) Monofloral Commercial Denominations

Concerning the monofloral commercial denominations the mat-

ter is quite simple. One should define the whole of the physical, chemical and sensorial norms, which should be characteristic for monofloral honeys to be promoted and to have a sufficient number of representative samples to carry out statistical averages. Thus, specific norms of composition for each of the honeys corresponding to the wanted denominations are determined. The control samples are chosen depending on the observations of forage, previously done at collecting time, and according to a pollenical analysis of control. Nowadays, there are for example, compared to the French legislation, *seven monofloral honeys* of which main characteristics have been recognized, enlisted and published. These are: *rape, rosemary, lavender, acacia, fir tree* and *heather,* the varieties *Calluna vulgaris* and *Erica.* The reader will find in Annex 2 the nomenclature on three of these honeys, considered the most currently used in Europe. Still, there are many other denominations for monofloral honeys, more or less spread on markets. Usually we find honeys like: *sunflower, clover, lucerne* or other leguminous plants, *thyme, rose, bay, dandelion, orange, lime, chestnut, eucalyptus, buckwheat,* etc. A team of Italian researchers has defined simple norms which allow for the determination of a dozen of such products. Annex 2 also gives the afferent cards for 4 of these honeys. By way of exception one may also find honeys with reference as being honeys from *savory, raspberry, bramble, ivy, waythorn, thistle, common sage, germander cherries* or other rosacease, *dill* etc. In fact, there are no limits since all the vegetal nectariferous species may be exploited by bees, but these denominations which are rare and unlisted are hard to be protected. Consequently, these are very frequently used abusively, although without any purposeful bad intention, in order to qualify the polyfloral products of which only a fraction, not always prevailing, derives from the essence they wish to promote. However, beware that if a sort of honey doesn't have the floral origin it has been given, this fact can be proved through analysis. The same could be done if one is not able to define the precise origin. If, through this method is being proved that a denomination is not correct, then it's a fraud who should be sanctioned. Broadly speaking, when we don't have the certainty of a monofloral origin commercially accepted for a honey, we would rather address to a speciality laboratory, for a note before making use of any reference.

Honeys and honeydew honeys deriving from a rape and prevailing vegetal source are very many all over the world. Among the most widely known we may quote: cotton *honeys, coffee* tree honeys, one species of *Rhisophora mangle, cock weed, milk weed, tobacco,* and other unknown hundreds on the European continent. In this respect, IBRA has published a list dealing on this matter of census of the world-wide melliferous resources.

Most frequently the monofloral honeys benefit from an even higher commercial value. These are mostly the big regions of mellife-

rous productions. However, when the yields are too big or have a mediocre quality as to the taste, then the contrary situation happens. Thus, in Europe, especially France, rape and sunflower honeys are not considered. At present these products represent a great part of the yields obtained by beekeepers. These are most frequently used in mixtures or sold while monofloral but bearing the label "polyfloral". Sometimes the sunflower is sold as a monofloral honey, but not always with success. Still, if these products are well prepared, they may be perfectly well accepted even though their aromas don't have a special fineness. However, these were never promoted. There are honeys which the beekeepers are ashamed of, for these are not "famous" and consequently, they do not promote them for sale. This negative attitude, and let's say completely subjective attitude, is not the one of a good taster. On the contrary, one should be objective and try to make a product be appreciated up to its original value. Let's admit that this sugar-like matter the honeybees take up from cultivated oleaginous flowers, doesn't make one dream of sweet, wild and perfumed honeys. Accordingly, for these products one should look for a revaluation based on criteria of intrinsical qualities; sensorial analysis should also contribute.

Among the most appreciated monofloral honeys, we may quote:

— *lavender honey,* white or golden, depending on its origin. It is rich in fragrance, and irresistibly reminds one of Provence and its perfumed plants;

— *officinal rosemary honey,* very light-coloured, finely aromatic, reminds one of the perfume of sandy moors covered with brambles from the Mediteranean seashore;

— *acacia honey,* one of the most light-coloured honeys, always liquid, pleasant and little aromatic, but very appreciated. This sort of honey is appreciated all over the world;

— *citric honey,* also very light-coloured, with a sublime fineness and delicacy, is undoubtedly one of the best honeys, impregnated with the subtile perfumes and aromas of orange flower;

— *rose bay honey,* foraged on the mountain heights and having the false reputation of being toxic; in fact it is a very light-coloured honey, fine and high quality. Foraged in the Alps, it has great refinement and elegance; it is less typical in the Pyrenees, its vegetal aroma reminding of the fresh wood;

— *savory honey,* once "collected" on the slopes of "Hymetus" mountain is a dark-coloured product. It is characterized through a vegetal aroma of wild plants; slightly acid and rather piquant in taste, it is very pleasant and has a moderate aromatic power. It is a very appreciated honey, especially when it is not pure, and it prevails within a natural mixture, as most of the times happens;

— *lime honey* has a strong menthol aroma, less fine than the previous ones, colourless, but very much appreciated;

— *chestnut honey,* tonic taste more or less exacerbated, strong,

persistent aroma. It is highly appreciated by beekeepers who are fond of strong, biting honeys;

— *bush honey,* an original product, giving off a strong bitterness. It is not highly appreciated on certain markets, but we may find it in drugstores;

— *heather honey (Calluna vulgaris),* quite strong, richy in taste, very persistent, but less bitter; a reflection of humid flora of the sandy moors;

— *fir tree honeydew honey,* very dark-coloured, taste of malt, a typical product of the forest and mountain.

The latter mentioned honeys, that is heather and fir, are the most demanded ones on the European market, because the consumer from the Central Europe, especially the Germans, appreciate these a lot.

Exception making the colour, still very few sensorial data are used in order to qualify the monofloral honeys. With the view to reach a rigourous and more efficient selection in this field, we should use a minimum usable vocabulary for all. We have already prepared ourselves for such kind of task and, as experimental title, by the end of the chapter we suggest some sensorial simple data which may help in classifying the monofloral honeys.

However, mention should be made that the taste of a monofloral honey may vary sensibly from one sample to another, depending mostly on the parameters of composition and the soil of origin. For example, as we have previously mentioned, the produced honey starting from the nectar of rose bay ferrungineum doesn't have the same aroma, depending on its area of origin: the Alps or the French Pyrenees.

As a rule, weakly aromatic honeys are liable to the most significant variations. However, differences in the intensity of perceived flavours could also be registered, depending mostly on the origin of samples, in the honeys with naturally higher aromatic intensity. The famous taste, the so-called "cabbage", typical for rape honeys, is a perfect example of such an asset. This particular aroma, generally qualified as harsh and less pleasant, is more or less pronounced in relation to the geographical origin of the products, although the cultivated oleaginous varieties are the same.

All in all, monofloral denominations of honeys are the easiest to be promoted. However, this commercial opportunity is slightly used on the world market, except maybe in Europe, where a progress is noticed. This may undoubtedly explain why the consumers or uninspired amateurs of the honeybees' product are always surprised to discover the diversity of flavours and tastes of honeys from different essences.

B) Different Regional and Polyfloral Denominations

Basical polyfloral denomination, which doesn't resort to any particular reference, is the honey usually called "all flowers" or more prosaically "out of one thousand flowers". Such a product, very common in fact, is sold without a precise distinctive reference point and has a low commercial value. That is why increasing efforts are made for the promotion of regional honeys which can be recognized and identified. However, the matters to be solved in order to characterize and render valuable in good conditions are multiple and complex. First of all one should choose the regions where the melliferous production corresponds, if possible, to a tradition that could be re-established. The collected quantities of honey from these regions should be sufficiently high so as to suit the exigences of the market. This implies a certain enlargement of the cultured area, of forest or wild sandy moors. Then it's necessary that the product we wish to promote should have a certain homogeneity after each forage or derive from a mixture of regional honeys. At the same time, this honey should also have several chemical, biological or sensorial peculiarities which would allow for its classification. Therefore, it's desirable that this product should have at least *one floral known component* and that the latter should be prevailing. And, the last imperative is that the polyfloral production, deriving from a limited region, speaking from a geographical point of view, should be sufficiently specific to the soil from which it is drawn. Evidently, this implies the condition that the respective region has phenological particularities. If the foraged polyfloral honey, although qualifiable, does not have significant original characteristics, its protection as regional product can hardly be done. Here is an example to illustrate this asset. The *Gatinais* French province once used to produce a light-coloured honey, very well known and appreciated by consumers. The floral basis of this popular and traditional product was sainfoin. Nowadays, the fodder type cultures have dissapeared from the region and were replaced with the yellow rape and sunflower ones. At present, the average *Gatinais* honey type can be collected in many regions in French and Europe also. Therefore, the denomination can hardly be protected. There are many more honeys which are sold bearing labels with various regional reference points. Even though most frequently these products are legal and correspond very well to the indicated origins, it happens very seldom that serious guarantees are brought for a perfect authentification of the source of such honeys. However, let's agree that their classification is difficult to be done. Since these are monofloral honeys with homogenous essence, the traditional analysis allows for the determination specific guide marks and relatively precise constants. Not the same is true for polyfloral honeys, which as the definition itself shows are variable. Broadly speaking, the ana-

lytical registered criteria are much larger and could not be considered as sufficient references. Consequently, in this field, an essential basis for the determination and the recognition of the difficulties it implies, either due to unsufficiency of data or lack of exactness, will serve the sensorial analysis and the pollinical examination.

Out of the most widely used references for honeys, we also find, for example, "mountain honey", followed by the name of the mountain, or "plain honey", "forest honey", "maquis honey", "des garrigues", etc. It could be very easily demonstrated that such products do not have commercial bases since they lack completely in exactness and vary considerably from one region to another. Thus, the so-called "forest" honey, coming from a region where coniferae prevail, is dark-coloured, its natural flavour, sufficiently sustained, reminding of "fried barley"; in fact, it most frequently refers to a disqualified fir honeydew honey, collected from other regions or in the same one by the end of spring. This can be rather light-coloured, with fine and subtle flavours, if collected from brambles, raspberry or bilberry. There can be very many of such examples of various mountain honeys. Even a plain honey can be rich in flavours if collected from clover, sainfoin, *Lotus corniculatus* or wild lucerne pastures; however, it will have a less elegant aspect if collected from dandelion or wild-radish. So there is a whole lot of very different products, which might be found in different places, presented under the same generical name. Consequently, such denominations offer no guarantee to the consumer and have no precise significance. It could have at the most the one of a local tradition which could be used for the place, but which is generally poorly exported.

Yet, there is no regional denomination really recognized and encoded in precise terms, so as to promote the polyfloral honeys. However, nowadays an effort is made in France and Europe. Let's quote some of the denominations which could be undoubtedly developed, mentioned or reactivated: "honey from Corsica", "honey from Narbonne" or "honey from Sologne". Here below, we shall develop these three examples taken from France within circumstances we know well. These possibilities, which in fact are not liable to be exploited in the country, are not limited only to France; the same possibilities are to be found in other countries of Europe and many more in the world. Thus, these could be transposed.

Corsica is an island; therefore a region easy to be delimited. On the whole, its honey production is quite enough, but the diversity of the melliferous resources in the region is so high that it is a very difficult job to have a product with relatively constant characteristics. However, one should get two or three denominations of the "Corsica" honey which can be distinguished, having as source some regulated mixtures, from local productions. For a better identification and separation of these products, analyses and researches should be carried out first, in order to determine the main physical, chemical and especially pollenical characteristics of these honeys; this was partial-

ly realized in Corsica. In the end, it's necessary to fix the criteria of sensorial quality which must be sufficiently precise and constant.

"*Narbonne*" *honey:* undoubtedly it's almost the oldest of all French melliferous productions known all over the world. The Romans took high delight in this sort of honey, which they used to buy from Phenician sailors at the beginning of the Christian era. There are historical records pointing to the flourishing trade with this product, considered in that period as "the best honey in the world". These records may be found in the archives of Narbonne town, dating from the XIth and the XIIth centuries. This white, tasty and finely aromatic honey, of an excellent commercial quality, originated from officinal rosemary. Nowadays, the denomination is almost forgotten. The rich yields obtained from officinal rosemary from the French Mediteranean waterfront are nothing but memories of an old beekeeper. At present, such honeys existing on markets are mainly imported from Spain, but are not pure. However, the region of Narbonne and the neighbouring one of Corbière still produce a polyfloral honey, a bit more coloured than the traditional honey of Narbonne. The floral base of this aromatic product is the officinal rosemary, savory, *Dorycnium* and other plants from the Mediteranean sandy moors. Such honey can be easily delimited as regards the production and easily identified for its essential characteristics, and consequently protected. In this view an analytical work (of the same kind as the one above-mentioned) is to be undertaken.

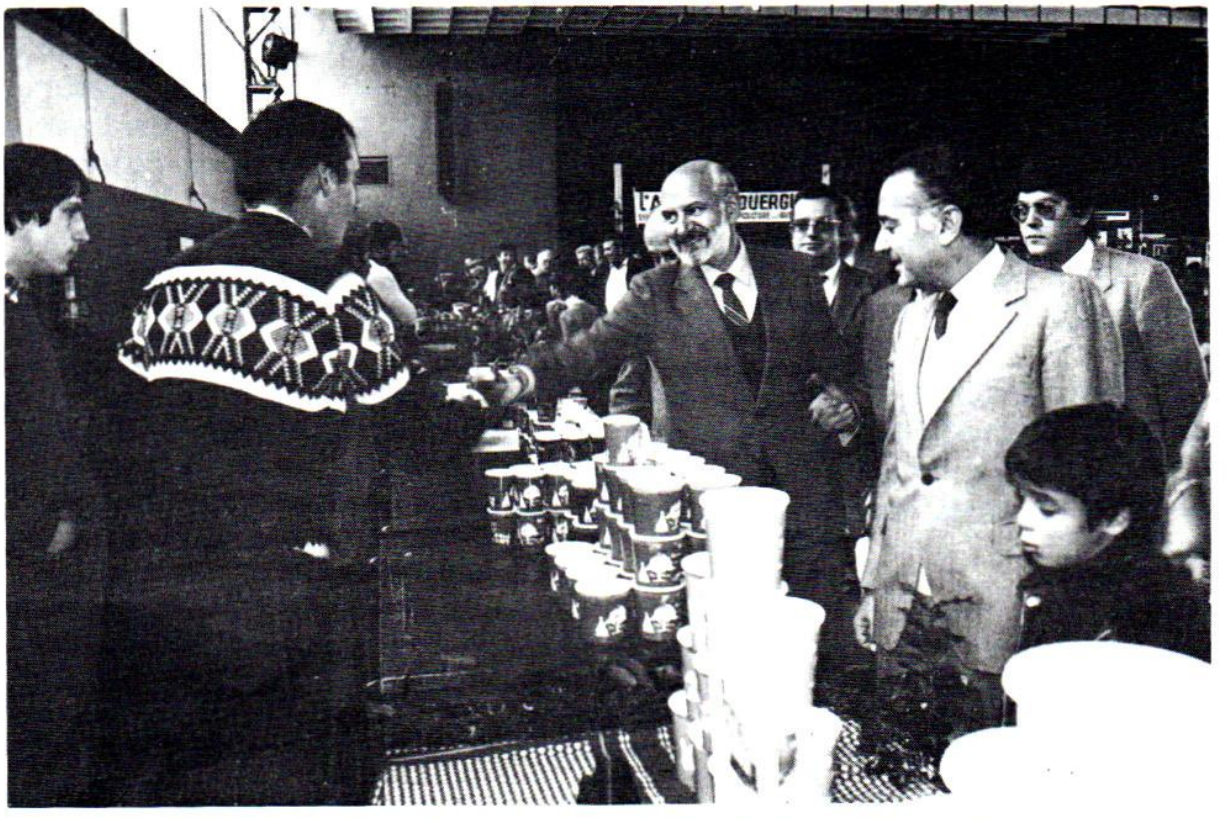
And finally, *Sologne* is a big area of swampy and silicious soil, situated in the Central France. The chestnut, the willow, the bramble and heather are the main melliferous sources in the country. Here, the bee management and honey production are traditional and are a constituent part of the local culture. The honeys are amber-coloured and reddish with a generally strong and persistent flavour. Since this original production complies with a tradition, it calls for its protection. It is a step which has been approached and which has lead to the foundation of a mark of "Sologne" honey, about which we will discuss later.

Some other melliferous productions in Europe were by the same means protected and re-evaluated. In the *Federal Republic of Germany,* for example, there is a deposited national mark. The *North* of Italy also has regional marks viewing to evaluate the typical local products.

C) Competitions, Labels and Different Commercial Denominations which Guarantee Honey Quality or Origin

A honey sold under the floral or regional denomination should benefit from a plus commercial value. However, it is not enough that its denomination is recognized officially, it is also important that the product for trade is of an excellent quality. The beekeeper's job is also involved to this point. The beekeepers will show a quicker progress in the field of selecting products of quality if their competition spirit is aroused and they get inspiration from the new techniques such as the sensorial analysis. If such a result is desired, then it's very indicated to organize regional or national competitions and to create quality labels which prove to be good in attaining such a result.

There are many beekeepers who dislike the apicultural competitions considering these as childish, unefficient and outdated. Certainly, they are wrong, since on such an event only the products with the highest chances to win are presented. Thus, this feature implies a continuous search for quality. Through its definition, a honey receiving a reward is considered a class product contributing to the product's better appreciation. In fact, it's an excellent advertisement and a remarkable test. In oenology, a quality wine wins its blazon only if it takes the first place in a great competition. The wine gro-



VII. Fig. 1. — *Regional honeys fair. Competition organized inside a fair-exhibition allowing the evaluation of honey from that district (Photo G. D'Hombres)*

wers know fully well about this and work hard for such a competition. The example being so appropiate, why shouldn't the beekeeper also try to find the best honey to take the first place? Naturally, this implies certain efforts, but that's the game, anyway. In this aim he should improve the techniques used of production and honey wrapping for sale, to get information on the new practices and means of their application. In fact, the beekeepers who actively participate, greatly enrich their experience and knowledge. Within the agricultural competitions, local or regional, when the soil's products are presented, the honey, although collected from the entire French territory, is most frequently absent. Let's remember that these meetings are always an opportunity for parties, and have a more or less important echo. In this respect, the competition is both an instrument promotion and an advertising remarkable support. We have noticed that an effort is being made at present to a better utilisation of such prospects.

A honey competition is prepared with many months in advance

Such a competition is preferable to be held in an enlarged framework of a honey fair. The competition should be announced in advance, and, in order to have an echo as big as possible, it's necessary to entail all mass media: radio, television and the press which should publish several articles on honey. On the day of the competition, the outstanding persons in the region will be invited, coming to bring

VII. Fig. 2. — *Honeys competition taking place within the framework of a big agricultural fair in France. This hall is polivalent. Wines, cheeses, olive oils and honeys competitions are taking place at the same time. In front, the table of honeys panel (Photo Michel Onuphre).*

their guarantee, thus emphasizing the importance of the event. Exhibition and selling stands allow for the presentation of various sorts of honey to a numerous public of uninspired consumers. However, since the competition is the main attraction in the show, it must be carefully prepared. The competition should have precise and objective regulations previously printed and also an organizing committee, especially created for this show, which will see that the regulations are applied. The beekeepers providing honey samples should completely follow the suggestions enlisted; namely: to present samples of honey from their own yield, in jars, with their commercial standard. All samples are nameless. Before the samples are presented to the Jury, it is desirable that several previous laboratory analyses were made to mention the quality of honey, on the one hand and to allow the elimination of faulty products on the other hand (see Annex 3). The Jury charged with the sensorial analysis should be competent since it gives the verdict. In all honey competitions, held all over the world, there is still no precise method used, each one applying his own experience. Nowadays, there is an increasing demand for notation cards made up of simple terms for objectivity (see chapter VI). These terms guide the taster's job and strengthen his remarks. That's how the competition gains in seriosity and, within such conditions, the show acquires a high promotional character. The prize list is promulgated, prizes, diplomas and medals are awarded to those presenting the best

VII. Fig. 3. — *International competition of mountain products in Grenoble, France. There is the honeys bay, almost 50 experts allocated to 12 panels will judge and classify almost 150 different monofloral and polifloral honey samples, all harvested in the mountains (Photo M. Gonnet).*

VII. Fig. 4.5. — *Competition at CASTEL ST. PIETRO TERME. Honeys are presented in glasses, but also in their original jars, with anonymously numbered labels (Photo L. Piana)*

products. Rewarded beekeepers may show the excellent quality of their honey using a rosette placed on the jars of honey. The rosette should have the place, year of the competition and the prize awarded.

Out of the competitions to which we have been invited and chaired, let's mention two of them, both important and of different character: *"Il premio Giulio Piana" in Castel San Pietro* in Italy and *"The competition of mountain honeys" in Grenoble,* France. In Italy the competition has a national character. It is annually held, devoted to the memory of G. Piana, an outstanding beekeeper and patriot of the country. It is a show, the success of which is increasing. In 1987 there have been 16 juries, each composed of three persons. They had to judge 350 samples of honey; almost 60 of these were rewarded. It is a great competition, purely apicultural; here is also organized an exhibition of apicultural equipment and products. The competition of mountain honeys takes place once in two years in the olympic town of the French Alps. It is organized in the impressive building of the great palace of exhibitions. In fact it is a multipromotional show, where a small place was granted to the honeys collected from mountain sites. The event chairing this important show is "The Great Fair for Mountain Sites Planning" (Le Grand Salon d'Aménagement Montagne) where are presented simultaneously the traditional and the rural activities of the mountain as well as modern equipment technologies and seasonal plannings of these areas. In the big competition of "Mountain products" the main products presented are the dairy products made by the European Community in these areas of high alti-

VII. Fig. 6. — *Two regional labels are officially granted for honeys in France. Controls are strict and printed labels with* logo *are distributed to the producers in a corresponding number to the declared quantities of honey.*

tude. This show has a strong influence and although the honey stands are somewhat overshadowed, one should be present and constantly progress if possible. In 1986, 150 samples of honey were given for evaluation to 40 tasters, who were divided into juries of five persons each. In 1988 there were 150 samples, divided into 8 different floral categories, admitted in the competition. It was then that for the first time the rewarded beekeepers were able to use the unique term of "collective mark", given by the organizing committee of the competition.

But, if the competition is a precise interesting show, only few honeys are rewarded. It never happens that the whole of a national production or regional is promoted even if it is revaluated through the impact of the show on the averages. The *labels* have a wider vocation. They represent an official guarantee of quality, confered on a country level or on a region for an entire selectioned production.

There are many kinds of labels under the aegis of various authorities. The most secure labels are issued by official boards (Chambers of agriculture, Approved promotional offices) which ensure the promotion of the products but which in exchange require serious guarantees. There are also labels endorsed by apicultural groups having union character. These associations are responsible for the "mark" they issue and they impose other guarantees and will make some examinations. And finally there are the "false labels", self-rewarded, most frequently wrongly defined, about which we shall discuss a little. *Official labels* for honey are the fewest. In France, on regional level, there are three and one in West Germany, on national level. Something about the French labels: two of them are awarded by the regional Chamber of Agriculture. The third one is more special, as it is a decision of the justice (the Court of Commerce) which nowadays makes jurisprudence and which allows to point out and to protect the denomination of "fir honey of Vosges". The two of the regional products receiving the labels, among which *lavender honey* of the Alps, Provence. The Gold Coast and the polyfloral honey of Sologne, the origins of which we have already mentioned. These two honeys were studied for their essential characterisitics, especially the lavender. The qualification and the protection of these noble products are supported by the previous information. The denomination of "lavender honey" is one of the most impressive in France. However, the production of this honey is not very great and has yearly a tendency of decreasing in proportion. On the market one may find honeys sold with illustrated labels with fields or lavender ears with the mention on it "lavender and other flowers". Sometimes the proportion of lavender nectar is quite low in these honeys. If it is desired to satisfy and respect the customers looking for pure, traditional and aromatic honey of lavender, then it's necessary to protect the denomination. This is the label's vocation. The origin guarantee is legalized through an official "logo" printed on the jar. The label is given only after a ca-

reful check made on production. There are examinations made on two levels. First in the laboratory, where honey should satisfy the common physical, chemical and pollenical analyses. There are several strictly limited norms as to the water content, HMF and sucrose percentage. These products are then given to tasters who will only then decide to which of them the label is to be given. It's important that mention is made here to certain facts about the methods of this original organoleptical examination which we have perfected. The commission of tasters gathers once a year. The members of the jury coming to evaluate and mark the honeys are of various professions. These are farmers, technicians, consumers. The official commissions that legalize are also represented. All of them should imperatively know the methods to be applied and to have a very good memory of the reference product to which each of the sample for competition is compared. The examination derives from the adaptation of ordinal notation system of competition, namely, the one described in the previous chapter. The evaluation is carried out on the visual, olfactive and gustative levels, according to the established methods. Tactile evaluation is omitted, because the honeys are submitted to degustation shortly after harvest and most of them have not completely acquired their final structure. Moreover, the analysed honey does not derive from a trade sample but from that obtained by a beekeeper. The latter may then modify the honey's structure,applying a suitable technology. Each honey receives a mark and all the samples comple-

VII. Fig. 7. — *Labels and "logo" for a regional trade mark required for Italian honeys.*

ting the average have access to the label (see chapter VI). No classification is made although the examinators have the necessary elements to make it. That is the only difference between such kind of examination and a competition. There is no super label. Subsequently controls on market will be carried out, so as to verify to what extent the quality of commercialized honeys correspond to the promoted products. To this point let's underline that, for a first stage the beekeeper is the one who selects and declares a certain amount of his production for which the label will be required. Drawings will be made out of this quantity and further analysed. Each beekeeper receiving the label will get a stock of tickets corresponding to the declared amount of honey. On the other hand the contracting beekeeper engages himself to work and prepare the honey within the best conditions of hygiene and using an adapted material; the label's chart of tasks foresees inspections in the places from where honey is extracted and put into jars. The quantity of honey delivered by the producer to the label should be rationally proportional to the number of hives of the owner. He cannot obtain, let's say, the guarantee for one ton of honey if he hadn't declared at least 10 hives previously.

Regional label "honey of Sologne" is very recent, inaugurated only in 1988. It is based on the same conditions and naturally it implies the same obligations. In fact, for the promotion of the polyfloral honeys of such kind, the deposited collective stamps should have the best impact in the future. But it so happens that the official foundation of such regional labels is only possible if there are necessary means to allow the correct definition of the denomination. That is not always a simple thing to do, sometimes being really impossible; it is in fact the matter we have made reference to above. We have defined several original particularities which allow the qualification of a honey of Sologne. In order to improve the mark protection the work has to be sustained. Mention should also be made that not all the honeys produced in the respective region have automatically access to the label. Only a selection of the yields made in the county, homogenous or mixtures, but corresponding to the denomination criteria, will be retained.

The West-German label is issued for honeys by a national office busy with the promotion of quality products. The deposited stamp (mark) as well as the official jar could be used by beekeepers asking for it and who engage themselves to respect the strict norms, pointing to the origin, purity and presentation manner of their products.

Regional labels which are not officially covered are undoubtedly more and easier to be imposed; however, the protection is also less efficient, very frequently. Still, these may be a good promotion when preceding researches, dealing on the originality of the product and the quality criteria which must prevail have been seriously conducted, allow such regulated controls on the harvests. Unfortunately, this necessity is most frequently neglected and on such a level a certain tolerance and even much fantasy is observed. However, in Fran-

ce, in the region Haute-Loire, for example as well as in the North of Italy, in Valtellina province at the border with Switzerland, or in Trento, one may find several types of distinct regional honeys, covered by controlled labels, coming from own initiative. These denominations have a very convenient protection and arouse the interest of both local consumers and tourists', since the quality of honey they are offered is always good and constant. However, as a general rule, *the so-called "guaranteed origin honeys"* or even sold under the ticket of a *regional stamp,* whichever and *nonlegalized* are products which bring no serious guarantee to the consumers. Still, mention can be made that these *honeys* which are also called *selected,* may happen to be of an excellent quality; in this way, the producer tries to promote his best products. These denominations have no protection, the consumer does not have a serious guarantee and no support at all. Within such circumstances the commercial interest of the operation seems to be completely ridiculous.

Among the "labels" or "pictures of wild stamps" which are still very frequently used so as to make a trial on a better sale of honey, let's quote the references to *domestic tradition.* It's not about a guarantee of origin nor of an absolute guarantee of quality. Broadly speaking, this reference which is a patronym or a company deposited by a beekeeper relies on trust; it is most likely connected to the local

VII. Fig. 8. — *In numerous zones in Europe honey markets are still practiced on a small scale, producer selling directly to the consumer. Selling on touristic roads or at the farms remains traditional, but that is why the quality of the products is not guaranteed. Here is a stand, among others, placed on one of the "lavender roads" in France (Photo M. Gonnet).*

market and it has a very traditional character. Therefore, it does not have the vocation to promote the whole of a regional production.

"Freshness", possible *"significant biological or dietetical virtues"* are also guarantees which are sometimes used for honey, as an addition to quality. Much prudence should be paid in this respect, first of all because the legislation is strict and any abusive advertisment on the therapeutical virtues of honey is forbidden, and it sometimes even happens that, according to the codes in force, it is severely penalized. But, insidiously, one may notice, for example, that the honey guaranteed as freshly collected, unheated, filtered at cool, etc maintains all its "vitamins" although it is a known fact that honey is one of those poorest in vitamins natural products. We may guess now the interest in the comment... It's in this very field of honeys with "dietetical mark" that most of the excesses are found, deceptive selling arguments, unfounded, sometimes even erroneous and always difficult to be verified by the one who announces them because in most of the cases he is not the producer, the bottler, if we talk about a contractor (who makes only a share of the work initially contracted by someone else). Sometimes, on this level, it happens a honey with visual or tactile faults such the white traces, impurities or suspensions following the lack of filtration, air bubbles, coarse granulation, is sold very expensively being naturally guaranteed, unheated, etc... and then one assumes that its faulty aspect is the very mark of quality itself... Although few, one may also see honeys fermenting and a deplorable physical state for sale in these shops. Broadly speaking, it's a true fact that the endorsers of such laboratories have little knowledge of honeys and their quality criteria. What should really be mentioned is that very many honeys sold in the dietetic department are serious products with satisfying qualities. Let's not forget that in fact all honeys are natural products, although the same is true that some of them show a superior biological quality over the others, resulting from a fresher product.

In spite of some excesses above mentioned, most of the honeys sold under a denomination coming to guarantee the origin of the place property or domestic tradition are serious and good quality products, however most frequently uncontrollable. These "private labels" that have been chosen and deposited by producers were not the subject of several more precise descriptions. That's the very reason why the risks of possible counterfeits and an abussive use of the "mark" are hard to be avoided. Undoubtedly, the sensorial analysis with good control honeys and competent tasters would contribute to a better protection of these products, at least of those which justify the presence on a quite important regional market.

The trade department in North America, the United States and Canada especially currently use a *classification of honeys on colour.* Thus, reference denominations were established: *extra white, white, extra light amber* (colour), *light amber, amber, dark.* As a rule, the

lightest-coloured honeys are the ones most appreciated by the middle American consumers. Such method of classification, although easy to be defined and controlled, doesn't seem to be of great interest and does not correpond in all cases to an intrinsical quality. It's true that the consumer from the United States, especially from the Southern states, most frequently is after the natural liquid sugar syrup in honey rather than the biological nourishment. From this point of view the European consumer behaves differently. He most frequently remains devoted to the traditional products of the place.

Broadly speaking, the promotion of honeys, either monofloral or polyfloral, displayed in a competition, sold under label or various

VII. Fig. 9. — *Exhibition with honey selling, coming from all zones, in a "fine grocer's shop". We find here a lot of different often fanciful denominations. Yet the general quality of the products seems to be satisfactory and presentation is good (Photo M. Gonnet).*

"marks", has to *take steps in accomplishing the presentation.* This effort is either realized on the level of the product's structure *or the used wrappers.* In trade, the sensorial appreciation of a product is very much based on the visual stimulation it arises. Therefore, it's necessary that a product is attractive so that it may be well sold. A liquid, perfectly clear honey presented in a transparent jar is, from this point of view, an appealing product. The same is valid for a finely crystallized, homogenous and creamy honey. Beekeepers should make efforts to regularly offer such products and to display these attractively. In this view the beekeepers may make use of all the resources which technology offers in this field. A study in the field of diver-

sification and originality might also be involved on the level of *choosing the wrappers.* The success of the traditional *"carboard container"* is very less used nowadays. It is an opaque wrapper and consequently *shows very little of the product;* moreover, it has many disadvantages. Therefore, it must be replaced with tranparent jars and *glass jars* especially. These may have different shapes. Whenever we want to point out a new honey, quality product sold with label, it is recommended that it be presented in an *original wrapping,* especially studied, and if necessary also with the mark. This jar which will be identified by the consumer will become the "mark image" of the product. Special attention should also be paid to the *ticket fabrication,* which will be painted and put on the jar. The latter is going to be an important and complementary guide mark for honey identification which we wish to revaluate. The *counterticket,* used more than ever, allows for several suggestions for the consumer, short notes, but precise on honey crystallization as well as on the best domestic means of remelting; this is valid for the amateurs of liquid products.

Another thing to be searched for is the *modern wrapping* adapted to use and the user. For example, *pipe wrapping,* aimed to promote the honey for sportsmen in training camps, to the mountain climbers, those inclined to camping etc... Such wrapping may also give pleasure to children and mothers who are always afraid of the unpleasant accidents while feeding the babies... Pipe honeys should be a remarkable way for promotion, making widely known the honeysbees' product and present it to the numberless consumers who do not know much about the honey structure. This fact may in time make them search comparable products in more traditional like wrappers. Certainly, there is a world honey market in pipes, although weakly developed. In order to satisfy such wrapping, one uses the naturally stable honeys in liquid state, but these products are quite scarce. Besides the EEC and in those countries where the legislation allows, the very strongly heated and superfiltered honeys may also be reserved to this use. This private market would become very interesting for the promotion of crystallized honeys, turned into a stable, homogenous and creamy state. At present, we know how to prepare such sorts of honey without bringing any change to the chemical and biological nature of the honeys.

The sensorial analysis leads to all these approaches of a vast contemporary and universal matter in all the developed countries; the study, the selection and the the preparation of quality products.

Attempt to organoleptically describe of some monofloral honeys

Honeys Denomination and origin	Sensorial description
ACACIA *(Robinia pseudoacacia)* FRANCE	*Apect:* when pure always a liquid honey Very light colour, sometimes white. *Smell:* at first pleasant and discreet of acacia flower. Then a weak but vulgar smell of thick cloth, of bath sponge. Sometimes we find accidents of wax, of smoke... *Taste:* delicate and less persistent, slight acacia flower fragrance. Hive smell. Sucrose stronger than in other honeys.
ALFALFA *(Medicago sativa)* FRANCE *(Champagne)*	*Aspect:* Very light coloured honey, white when crystallized. Fine, natural crystallization in general. *Smell:* Very weak (at the perception limit) more neuter than in acaia, but more elegant and refined. *Taste:* Very weak, but very fine fragrance. Sucrose stronger, in contrast to its weak fragrance. Resembling acacia, a fragile honey and susceptible of accidental aromatic pollution (smoke, nitrobenzene etc...)
ROSEMARY *(Rosmarinus officinalis)* FRANCE *(Languedoc-Roussillon)*	*Aspect:* Light coloured honey, white when crystallized, natural fine up to medium crystallization. *Smell:* Vegetal of Labiate, slightly balmed, less intense, still very easily perceptible. *Taste:* In the mouth this vegetal aroma, pherhaps due to an after consuming taste of "wet flour", is more intensely rediscovered.
RHODODENDRON *(Rhododendron ferrugineum)* FRANCE *(Pyrenees mountains in Ariège)*	*Aspect:* Very light coloured honey, white in a crystallized state. Fine, medium or rough crystallization. *Smell:* Slight vinegar smell (ethyl acetate), of smoke, of soot, but balanced and not quite disagreeable. *Taste:* Intense enough and persistent fragrance level. Wooden aroma that reminds of a "cheese box", of chocolate covered icecream.
ORANGE *(Citrus aurantium)* U.S.A. (Florida)	*Aspect:* In general light yellow till medium bright yellow colour, this honey remains liquid for a short time, crystallizing afterwards into medium and rough granules. *Smell:* Medium intense; smell of orange in bloom, more or less exacerbated depending on the freshness of the product. *Taste:* Strong enough marmelade aroma, of orange liqueur.
LEMON *(Citrus limonum)* ITALY (Sicily)	*Aspect:* Resembling to the orange one. Perhaps less light in colour. When crystallized white "cassé". *Smell:* Resembling to the orange one. Perhaps less pronounced citric intensity *Taste:* Persistent aromatic intensity. Slightly "salted" savour for certain tasters (phenomenon that could be linked to a soil peculiarity).

CLOVER *(Trifolium pratense)* CANADA	*Aspect:* Lightly coloured honey up to light enough, rapid and fine natural crystallization. *Smell:* Olfactory sensations of herbs, of cumarin, raised enough threshold. *Taste:* Strong enough aroma. Recalls that of milk caramels. Dry saliva. Low till medium persistence.
RAPE *(Brassica napus Var. oleifera)* FRANCE	*Aspect:* Light yellow till straw yellow, not too bright when liquid. Honey with a very rapid and very fine natural crystallization, with an ashen white aspect when crystallized. *Smell:* a more or less exacerbated smell of "cabage", depending on the origin that serves in general to qualify this type of product, but which is not recognised as such by tasters. They rather identify a vulgar, rough, less agreeable smell recalling straws, a straw bed. *Taste:* A lot less disagreable than the smell. Slightly recalling the olfactory stimuli. Some analogies to alfalfa honey, but less "milk caramels" than this one.
LAVENDER *(Lavandula officinalis)* *(L. officinalis x L. latifolia)* FRANCE (Provence)	*Aspect:* The lavandine honey (cultivated hybrid) is a light coloured honey, white when crystallized. Lavender honey is rather gold yellow with a light yellow aspect when crystallized. Crystallization that occurs more or less rapid is, in general, from fine to medium. *Smell:* Slight lavender smell ,reminds some people of the smell of Mediterranean lavender flowers (*Lavandula stoechas*). Smell of boiled vegetal, of week lavender infusion. *Taste:* Strong enough aroma straightly recalling the olfactory sensations. Medium persistent. Marked enough acid savour, especially in the lavender case.
THYME FRANCE *(Larzac)* ITALY	*Aspect:* Colour medium till dark enough, redly tinted, according to purity and origin. Crystallization occurs in an average interval of a few weeks after harvesting. *Smell:* Strong enough, more or less of aromatic herbs, with degrees and intensity varying according to purity. When this honey comes almost exclusively from thyme (certainly a rare enough occurence) the smell becomes very heavy, tiresome, pungent and rather reminds one of petrol than herbs. *Taste:* Strong, heavy aroma, very persistent and less delicate when honey is pure. Diluted with other nectars with more neutral aroma, the wild herbs fragrance is predominant and becomes perfectly bearable, even agreeable. Characteristic and well marked natural acidity.
SUNFLOWER *(Helianthus annuus)* FRANCE	*Aspect:* Canary yellow colour, more or less intense depending on origin. Very bright and very pure. *Smell:* Smell of wet straws, of fresh pollen. *Taste:* The same — reminds a steam processing site for straws. Aroma of pollen foraged by bees.

LIME *(Tilia)* FRANCE (Paris area)	*Aspect:* Light yellow colour till dark yellow depending on origin (nectar or lime honeydew or their mixture) *Smell:* Strong and persistent enough with mentholate character. *Taste:* Very strong aroma of lime and menthol infusion, for some people, reaching the allowed limit. Persistent medium. Often leaves a certain bitterness at the back of the mouth.
ANISE *(Anethum foeniculum)* FRANCE (Yonne-Ricard cultivation zone)	*Aspect:* Dark honey (dark brown). It remains liquid for a long time; we do not possess information on the product in its crystallized state. *Smell:* Very intense and complex smell of mustard, of dried flowers, of sweet wood. *Taste:* Slightly musty nut smell, boiled anise, persistent aroma.
WAYTHORN *(Rhamnus frangula)* FRANCE (South-West)	*Aspect:* Dark honey (reddish-brown when pure) it remains liquid for a long time *Smell:* Complex. First of all a slight but vulgar smell of sheep stable, of kennel; then secondarily, or when combined, a more pleasant balm smell that tends to dominate. *Taste:* Raised aromatic level, reminds of expectorant syrup. Persistent medium. Pleasant or unpleasant according to the tasters.
DANDELION *(Taraxacum-dens-leonis)* FRANCE (Central mountain mass)	*Aspect:* Goldish yellow, very pure brightcolour. Resembling to the sunflower one, in general, rapid, fine crystallization. *Smell:* Vulgar, disagreeable and intense of urine, of crushed dandelion flowers. *Taste:* A lot less disappointing, resinous aroma, sweet wood, almost fine and without exactly recalling the olfactory stimuli. Slight bitterness at the back of the mouth- persistent.
IVY *(Hedera helix)* FRANCE	*Aspect:* Dark honey, less bright. Fine and undoubtedly very rapid crystallization. *Smell:* Less intense, very weakly, reminds the ivy flower. *Taste:* Clear enough ivy flower fragrance. Sensibly astringent and slightly bitter-persistent.
WHITE HEATH *(Erica arborea)* FRANCE (Cevennes)	*Aspect:* Dark brown honey. Fine crystallization, rapid without doubt. *Smell:* "Cocaine" smell, sweet wood, fresh tannate leather. *Taste:* Aroma of dark caramel (typical)-of cocoa.
HEATHER *(Erica cinerea)* FRANCE (Landes)	*Aspect:* Dark brown honey. Rapid crystallization, fine *in general.* *Smell:* Straw smell, sweet wood to some people, it recalls the rose; yet somewhat heavy and very different to the heath one. *Taste:* Complex and intense aroma, but not the typical caramel, of the preceding one. Persistent. It seems slightly salted with a bitter background.

HEATH *(Calluna vulgaris)* FRANCE (Landes)	*Aspect:* Dark, less bright honey, often with a reddish tinge (varying according to origin). Very characteristic honey through its tixotropic tendency, always appears as a more or less jelly mass. *Smell:* Typical intense and very persistent. *Taste:* Intense and very persistent aroma directly recalling the olfactory stimuli — bitterness at the back of the mouth, more or less intense according to the water content. As this type of honey is also characterized by a very raised natural moisture content (between 18 and 23% water) bitterness is genuine when the product contains 18% water and practically neglijible above 21%.
EUCALYPTUS *(Eucalyptus)*	*Aspect:* Dark brown honey — medium sized granules crystallization. *Smell:* Wet dog, very intense and without recalling Eucalyptus. *Taste:* It is not very pleasant — old glue aroma — somehow lack of fineness.
"JURA" FIR TREE *(Picea abies)* FRANCE	*Aspect:* Honey of dark honeydew honey (brown tinted reddish) bright enough, it does not crystallize in general. *Smell:* Expectorant syrup and resinous sweets smell (with resinous taste). *Taste:* balmed, mentholated aroma, of malt.
VOSGES FIR TREE *(Abies pectinanata)* FRANCE	*Aspect:* Honeydew honey, darker in general than the preceding one, with typical green reflections, less bright, liquid, but sometimes crystallizes into large granules (green aspect of the mass). *Smell:* Slightly resinous and medium intense expectorant syrup smell. *Taste:* Balmed aroma and malt taste typical to fir tree honeydew honeys.
CHESTNUT *(Castanea sativa)* FRANCE (Cëvënnes)	*Aspect:* Light brown honey to very light, depending on origin. It remains liquid for a long or short time, then crystallizes in general into large granules. As in lime, very often it can be found mixed with nectar and lime honeydew. Frequent moisture excess that makes this honey fragile with tendency towards phase separation. *Smell:* Strong and penetrating smell somehow recalling that of rotten apples (ethanol). *Taste:* Exacerbated, recalling the olfactory stimuli. Tannic enough, astringent, very persistent. Bitter, more or less strong, but always very marked savour.
ARBATUS *(Arbatus unedo)* ITALY (Sardiny)	*Aspect:* Brown honey with fine and certainly rapid crystallization *Smell:* Less intense. *Taste:* Weak acroleine smell, weak taste of burnt organic matter. Honey characterized by *strong bitterness* (wholly unacceptable to some people due to arbustine).

BUCKWHEAT *(Fagopyrum esculentum)* CHINA	*Aspect:* Very dark, almost black honey — crystallizes. *Smell:* Strong, reminding the methatartric acid, flax flour, carob. *Taste:* Musty aroma, carob taste. Heavy and very vulgar aroma. Persistent, detestable.

(1) The main sensorial characters of monofloral honeys we have already described are susceptible to some variations from one sample to another. These qualitative differencies can spring from different origins; for example:

— geographic origin of these products;

— eventual mixtures of nectar and honeydew from the same botanic source;

— water content of honeys that can vary from one year to another.

Regarding *the aspect: colour* can vary sensibly, it is observed on the liquid product; regarding *crystallization* we can define only a natural tendency as the nature and rapidity of this phenomenon essentially depend on the water content in honeys.

— *Smell, aroma and taste* are more constant for the same type of product; yet differencies can be registered at the level of the intensity of perceived aromas, especially according to the sample's origin. More or less qualitative differencies can be discerned when the same plant produces nectar or honeydew, or both combined.

This study was accomplished by Messrs:

BEDOT Pierre, oenologue, Vicepresident of the National Union and the International Oenology Union.

BURET Michel: National Institute of Agronomical Research (Institut National de la Recherche Agronomique).

FAUVET Jacques: oenologue, Technical Director of Trade Unions in Côtes de Provence;

LHERITIER Joël: France-Midi Cooperative;

PLATON Robert: Institut National de la Recherche Agronomique.

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Conclusions

At all times honey has been considered as an old traditional remedy, with a rich history and deriving its aura from the ancient mythology itself. Into this second half of XXth century it is still sometimes used as medicine, but most often people look for a food rich in glucose and fragrantly delicious. Although in a clear progress, honey consumption still rèmains modest. It is traditionally consumed in well-off media and at the country; presently it is increasingly used into country and urban homes. Children craving different sweets, still use very small quantities of honey, although in the infantile diet it is preferred to traditional sugars. But, undoubtedly, the product has not been well presented and made attractive to the children. An effort has to be made in this direction and a study has to be carried out.

To eat honey represents an act deriving from a healthy food diet, but most often satisfies the legitime consumer's craving. Yet this does not belong to a scientific and technical discipline and everybody proceeds as or when he or she wishes. On the country, tasting is an art, it derives from an authentic intellectual act that has its own exigencies and needs serious apprenticeship. Up to now almost no one has been thinking to raise honey tasting to the level of a conventional and methodical discipline. The traditional honey consumer is seeking for a healthy food, natural beneficient to health and sometimes with therapeutical properties. He is rarely required to deliever a precise sensorial analysis. It is true the two approaches are not absolutely incompatible to one another, but for the person who is making the sensorial analysis the second has always to precede the first. It is an old "culture" of organoleptical evaluation of honey. Especially into the ancient Greek philosophers' works, as well as in certain Biblical poems or Koran verses there are very affectionate descriptions of the bee's product. But no contemporary work, nor a serious compilation were conducive to an outstanding study of this research discipline dedicated to the sensorial qualities of the hive main product. For example, formation of tasters into this field has never been taken into consideration. We wished to fill this gap and *for the first time,* as we know, *an experimental and complete work of sensorial analysis of the bee's product* has been accomplished.

The study we have achieved allows the definition of the criteria,

to precise and establish sensorial standards of qualities of certain honeys. This normally led us to devise an evaluation system in numbers of the defects and qualities of a product that followed to be judged in visual, olfactory, gustatory and tactile fields. The method of defects evaluation is objective. Quality evaluation is less subjective, yet compensated by the indispensable knowledge on reference witness. The ordinal notation scale adopted by us allows the integration of all these data, and the taster is required to finally choose from a number of possibilities that happens to be very limited which lead to coherent and reproductible results. Proposals formulated here can serve as basis for the elaboration of an official methodology of honey tasting. The delivered results complete and underline some more conventional analytical parameters. All beekeepers preoccupied to revaluate their products can therefore get immediate information from this work and the methods hereby enclosed to better ensure their promotional approaches.

We also demonstrate in this study that tasting apprenticeship is an exercise that leads to restraints and, first of all, needs perfect knowledge on the product, its essential characters and technology. This formation also presupposes the acquiring of elementary knowledge in the field of anatomy and physiology of senses. Finally, regular practice of different recognition and differentiation tests of honeys is indispensable in order to get good results. The stages of sensorial analysis we undertook and continue to diversify will allow the beekeepers' training or, pure and simple, of the honey amateurs' in this exigent discipline. The formation of a genuine body of tasters susceptible to organize and animate competitions, to grant labels or, more commonly, to be able to recognize and confirm the origin of honey is one of the objectives of this action. But, in our thinking, the global project is more ambitious. It is necessary for the beekeeper to become a technician and expert at the same time, to be able to evaluate his products, to ensure a real promotion of his harvest. The formation as a taster answers this objective. It should be seriously guided, it requires a long time and sustained intellectual effort by the dedicated people. It is desired that the young beekeepers participate in this type of collective formation; the profession in general will be put into value and, therefore, has to gain.

Finally, the last objective that has to be attained to usefully complete this research: a certain mastering of the vocabulary. This has to faithfully translate the perceived sensations by the taster. Recognition of smells and floral and vegetal aromas in honey, already perfectly identified somewhere else, could serve as basis to establish an elementary lexicon that would allow a better definition of "the taste" of honey. But in order to recognize all these aromas you have to know them well, to have been perceived, identified and qualified them during some current exercises. In general, the descriptive sensorial analysis is the worst to be mastered, the chosen words should have a

precise significance and therefore the same meaning to all. This analysis should be true and reproductible. To this end the adopted language has to be clear, simple, precise and translate certainties. We have made a few interesting preliminary attempts in this field:

— first by putting forward a useful basic vocabulary for a sensorial description of all honeys;

— then trying to accomplish a specific descriptive analysis on about twenty monofloral honeys.

For the second attempt, wholly original, we often lacked references and precise terminology to identify and qualify all the perceived sensations.

Research undertaken in this field aimed at the improvement of quality and precision of language will take a long time, is delicate and needs perseverence; it will necessarily involve good knowledge on the main elementary aromatic constituents contained in each honey.

The dictionary where all terms of a complete descriptive analysis of a honey can be found is therefore still to be achieved, yet this current study constitutes a decisive step forward towards attaining this objective.

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ANNEX 1

DECREE ON HONEY

This decree is in force in all European Community countries

Art. 1.

1. In the acception of the present decree, by honey, a food article produced by melliferous bees from the flowers nectar or secretions coming from live parts of plants or which are on them, that they forage, transform, mix with their own specific matter, store and leave to maturate into the hive combs is understood. This food article can be fluid, thick or crystallized.

2. The main varieties of honey are the following:

a) According to origin:

Nectar honey: honey mainly got from the flowers nectar;

Honeydew honey: honey mainly obtained from secretions that come from the live parts of the plants or that can be found on them; its colour ranges from light brown to greenish brown with an almost black tinge.

b) According to the method of obtaining it:

Honey in combs: honey stored by bees in the capped cells of combs freshly built for them, that do not contain brood and sold in combs, whole or not; honey with pieces of combs; honey containing one or more pieces of honey in combs;

Drained honey; honey obtained through draining the uncapped combs that do not contain brood;

Centrifuged honey; honey obtained by centrifugal force from the uncapped combs that do not contain brood;

Pressed honey; honey obtained by pressing combs that do not contain brood; without moderately heating them.

Art. 2.

It is forbidden to detain for selling or to put on the market or sell or distribute freely under the label of "honey" with or without a further specification:

either a product that would not answer definitions and rules contained into the present decree and in its annex;

or a honey to which another product that honey has been added.

Art. 3.

The name of "honey" is reserved for the product defined in Article 1 (§ 1 and 2).

Art. 4.

Denominations mentioned in Article 1 (§ 2) are reserved to the products that are defined there.

Art. 5.

1. When marketed, honey has to correspond to composition elements ennumerated in the annex.

2. Moreover:

a) If possible, honey should not contain organic or inorganic matter foreign to its composition, as for example, musts, insects, insect residue, brood or sand grains when it is marketed as such or when it is used into a different product meant for human consumption.

b) Honey should not:

I) Present a foreign taste or smells;

II) Begin to ferment or become effervescent;

III) To have been previously heated, so that natural enzymes were destroyed or considerably inactivated;

IV) To present an artificially changed acidity;

c) In any case, honey should not contain any substance in a quantity that would put human health in danger.

3) By derogation from paragraphs 1 and 2 it can be marketed under the name of "pastry honey" or "industrial honey" a honey that even appropriate for human consumption:

a) Does not answer the exigencies of paragraph 2b I, II and III or

b) Present a diastasic index or a hydroximethylfurfural content that does not correspond to the fixed norms in the annex.

Art. 6.

1. In spite of the provisions of Articles 3 and 6 and Article 2 (paragraph 2) of the above-mentioned decree from 12th October 1971 the compulsory endorsements that have to be made on packages, containers or honey labels that are required to be very visible, clearly legible and not erasable, are the following:

a) Denomination "honey" or one of denominations enumerated in Article 1 (§2); in spite of these, honey "in combs" and honey "with comb pieces" has to be designated as such; in cases mentioned in Article 5 (§3, paragraph 1), the denomination of the product has to be "pastry honey" or "industrial honey";

b) Net weight expressed in grammes or in kilogrammes;

c) Name or firm and address or headquarter of the producer or package firm or of a seller established inside the Community;

d) Indication of the country or origin for honeys coming from countries that are not inside the Community;

e) Mention "mixture of imported honeys" in case of mixtures of honeys coming from countries that are not inside the Community; mention "mixture of honeys of different origins" in case of mixtures of original honeys, on one side from countries inside the Community and, on the other side, from countries outside the Community.

2. Denomination "honey" mentioned in paragraph 1 a or one of denominations from Article 1 (§2) can be completed among other things with:

a) An indication linked to the floral or vegetal origin if the product mainly comes from the indicated origin and if it possesses its appropriate organoleptical, physico-chemical and microscopial characters; when necessary these characters are fixed by a decision of the Ministry of Agriculture.

b) A regional, zonal or topographic name if the product comes from the indicated zone.

3. If honey is conditioned in packages or containers with a net weight equal or more than 10 kg and is not retailed the provisions of paragraph 1 b and c cannot be followed with the exception of the accompanying documents.

4. Notices mentioned in paragraph 1 a should be made on one side of the package or container.

Art. 7.

The above Decree of 12th October 1972 can be applied to the products referred to in the present decree with all provisions that are not contrary to those contained in the mentioned decree.

Art. 8.

Joint decisions of the Ministry of Agriculture and the Ministry of Economy and Finance can fix net weights in which the prepackaged honey is going to be retailed, exclusively marketed and sold.

Art. 9.

The current decree does not apply to the products meant to be sold outside the Community.

Composition characters of honeys

1) Content in reductive sugars, expressed in inverted sugar:

Nectar honey: not less than 65%;

Honeydew honey, alone or mixed with nectar honey; not less than 60%.

2) Water content:

In general: not above 21%.

Heath honey (**Calluna**) and alfalfa honey (**Trifolium sp.**): not above 23%.

3) The apparent saccharose content:

In general: not above 5%.

Honeydew honey, alone or mixed with nectar honey, acacia, lavender and **Banksia mensiesii** honeys: not above 10%.

4) Content in matter insoluble to water:

In general: not above 0.1%;

Pressed honey: not above 0.5%.

5) Content in mineral matter (ashes)

In general: not above 0.6%;

Honeydew honey, alone or mixed with nectar honey: not above 1%.

6) Content in free acids:

Not above 40 miliequivalents per kilogram.

7) Diastasic index and content in hydroximethylfurfural (HMF) determined after treatment and mixing:

a) Diastasic index (Schade scale).

In general: not below 8;

Honeys with a weak enzymes content (for example citrics honeys) and a content in HMF not above 15 mg per kilogram; not below 3.

b) HMF:

Not above 40 mg per kilogram (under the reserve of provisions endorsed at point a, paragraph h 2).

ANNEX 2

A. CHARACTERISTICS OF SOME MONOFLORAL HONEYS AND HONEYDEW HONEYS FROM FRENCH PRODUCTION:
established by ITAPI working group (Beekeeping Technology Institute), France

— ACACIA HONEY —

DEFINITION. Acacia honey is a honey produced by bees out of acacia nectar *(Robinia pseudoacacia* L.)

PRODUCTION AREA. Acacia honey can be produced on the whole French territory, wherever there are sufficient acacia trees. Acacia woods are spread over large areas in France; to quote the main production areas: North of Rhône Valley, Gironde, Center and East of the country.

FORAGING PERIOD. Acacia honey is foraged in May-June.

DESCRIPTION

Organoleptical characters. Weak, sweet floral smell. Less pronounced savour. Raised sweetening power.

Colouring. Maximum 3 on Pfund scale.

Crystallization type. Very slow crystallization that can appear after quite a number of years.

Viscosity. Normal

PHYSICO-CHEMICAL CHARACTERS

Water content. In general below 18%.

pH	pH Units	
	Medium	Limit values
initial pH	3.92	3.7—4.1
equivalent pH	6.38	6.1—6.9

Acidity	Miliequivalents per kilogram of honey	
	Medium	Limit values
Free acidity (for equivalent pH)	8.0	5.7—11.9

Combined acidity (lactone)		5.5	2.2— 9.4
Total acidity		13.7	8.9—20.4

Electrical conductivity. Very weak. Ranged between 1.3 and 3.0 x 10^{-4} s. cm^{-1}

Sugar spectrum		Medium	Limit values
Monosaccharides	Glucose	34.30	29.2—38
	Fructose	49.21	44.7—53.7
	Total		
Disaccharides			
	Sucrose	2.51	0.5— 9.1
	Maltose	7.07	5.80— 8.60
	Total		
Trisaccharides			
	Erlose	0	0
	Melesitose	2.75	1.20— 4.26
	Total	0	0

Fructose/glucose relation (F/G)
Medium 1.43. Limited values 1.32—1.56.
Glucose/water relation (G/W)
Medium 1.63. Limited values 1.48—1.80.
Mineral matter. Very weak. In principle less than 0.1% out of the dried matter weight contained in honey.
Proteids. Very weak.
Amilase. Index ranged between 10 and 20. Not less than 10.
POLLINIC SPECTRUM. In general acacia honeys are poor to very poor in pollen. Acacia pollen present in variable proportions can be very small. Accompanying pollens are those of plants that bloom in spring: fruit trees, willow trees, crucifers, sage, dandelion, etc...).

— LAVENDER HONEY —

DEFINITION. Lavender honey is honey produced by bees out of *Lavandula vera* D.C. and sometimes *Lavandula latifolia* L. (Lavande) nectar, as well as from the hybrids of those two species (lavandine), but excluding *Lavandula stoechas* L.
PRODUCTION AREA. Lavender honey is exclusively produced in the South of France and especially in South-East.
FORAGING PERIOD. Lavender honey is foraged from July till August.
DESCRIPTION
Organoleptical characters. Floral smell characteristic of lavender. Very aromatic savour.

Colouring. Varies according to botanic origin; it should not surpass 5.5 on the Pfund scale.

Crystallization type. More or less rapid according to botanic origin crystallization is in general more rapid and finer for lavandine, slower and somehow rougher for lavender.

Viscosity. Normal

Water content. Weak in general: in principle less than 17.5%

pH

	pH Units	
	Medium	Limit values
initial pH	3.63	3.30—4.0
equivalent pH	6.34	6.0—6.7

Acidity	Miliequivalents per kilogram of honey	
	Medium	Limit values
Free acidity (for equivalent pH)	19.0	11.6—26.2
Combined acidity (lactone)	15.3	10.0—21.4
Total acidity	43.2	26.0—40.6

Electrical conductivity. On average 2.5, it does not go above $4 \times 10^{-4} S.cm^{-1}$

Sugar spectrum

		In % dry matter in honey	
		Medium	Limit values
Monosaccharides			
	Glucose	38.72	36.90—42.20
	Fructose	41.91	40.50—45.20
	Total		
Disaccharides			
	Sucrose	7.54	2 —11.60
	Maltose	5.53	4.20— 7.10
	Total	13.30	8.50—18.90
Trisaccharides			
	Rafinose	0	0
	Erlose	2.12	1.20— 4.30
	Melesitose	0	0
	Total	2.12	1.20— 4.30

Fructose/glucose relation (F/G)

Medium 2.00. Limited values 1.80—2.20.

Mineral matter. Weak medium content.

Amilase. Index not less than 8. Lavandine honeys are much poorer than lavender honeys.

POLLINIC SPECTRUM. Content in lavender pollen ranges from normal to weak in honeys coming out of lavender. For honeys coming from lavandine the content of lavandine pollen is extremely little. Moreover, these plants being sterile, the majority of these pollens are aborted. The accompanying pollens are in general those of Mediteranean flowers of the type:*Centaures, Cistus, Helianthemum, Olea, Saturea etc...*

— FIR TREE HONEY —

DEFINITION. Fir tree honey is honey produced by bees from honeydew foraged on the fir tree (in the form of pecten of comb) (*Abies pectinata* Ink). By analogy, taking into account that "fir tree" means in a very large acception the fir tree (in the form of pecten of comb), as well as the resembling conifers, we can admit that "fir tree honey" denomination is applicable to honeydew honeys coming out of vegetal genus *Abies* and *Picea.*

PRODUCTION AREA. This area is limited to important forestry mountain mass in Vosges, Jura, Alpes, Central Mountain Mass, Pyrenees and Normandy into which the essences defined above dominate.

FORAGING PERIOD. In favourable years fir tree honey can be foraged beginning from July till October.

DESCRIPTION. Vosges fir tree honey being sometimes somehow different from other fir tree honeys produced in France, we have to set up general norms, on one side, and, on the other side, different norms for Vosges.

Organoleptical characters: for all fir trees: weak smell; characteristic malt flavour, lack of bitterness. Sweetening power smaller than in the majority of honeys.

Colouring

Vosges: minimum 9 on Pfund scale.

Other fir trees: minimum 6.5 on Pfund scale.

Crystallization type

Vosges: very slow or even absent.

Other fir trees: variable; from rapid to very slow, depending on origin.

Viscosity: Normal.

PHYSICO — CHEMICAL CHARACTERS

Water content: all fir tree honeys have in general a water content below 18%.

ph

pH	Vosges fir tree		Other trees	
	pH Units		pH Units	
	Medium	Limit values	Medium	Limit values
initial pH	4.60	4.0—5.0	4.90	4.6—5.3
equivalent pH	7.37	7.0—7.8	7.34	7.0—7.6
neutralization curve	0.72	0.6—1.2	0.77	0.6—1.0

Acidity	Vosges fir tree		Other fir trees	
	Miliequivalents per kg of honey		Miliequivalents per kg of honey	
	Medium	Limit values	Medium	Limit values
Free acidity (for equivalent pH)	25.2	17.4—31.2	19.8	14.4—26.2
Combined acidity (lactone)	3.4	0.4— 9.0	3.0	1.0— 8.5
Total acidity	28.7	20.4—36.9	22.9	15.8—30.6

Electrical conductivity: raised for all fir tree honeys; it should not get below 9.5 x 10^{-4}S. cm^{-1}

Sugar spectrum

		Vosges fir tree		Other fir trees	
		in % of dried matter in honey		in % of dried matter in honey	
		Medium	Limit values	Medium	Limit values
Monosaccharides					
	Glucose	33.46	29.50—37.30	32.33	27 —35.70
	Fructose	40	36 —41	37.11	33.30—41.50
Total					
Disaccharides					
	Sucrose	0.56	0.20— 1.20	0.64	0.10— 1.20
	Maltose	4.63	3.70— 6.10	4.78	3.60— 6.80
	Total	11.74	9.40—14	10.89	8.50—13.60
Trisaccharides					
	Rafinose				
	Erlose				
	Melesitose	2.40	0.90— 5.50	8.80	2.90—15.70
Total		6.30	2.30—12	11.73	6.40—17.40

Mineral matter: Raised content for all fir tree honeys: up to 1.5% of the dry matter contained in honey.

Proteids: More important presence than in the majority of flower honeys.

Amilase: Above 20% for all fir tree honeys.

POLLINIC SPECTRUM. Fir tree honeys are poor in pollens of nectariferous plants. They comprise regularly pollen of anemophile plants as *Plantago, Rumex,* different graminaceae.

The most characteristic microscopic elements are fumagine spores, mycelium fragments, microscopial green sea weeds.

B. CHARACTERIZATION SCALE OF THE MAIN QUALITIES OF SOME ITALIAN HONEYS

According to Marco ACCORTI, Livia PERSANO ODDO, Maria Gioia PIAZZA, Anna Gloria SABATINI, *Italy*

— CITRUS MONOFLORAL HONEYS —

ORGANOLEPTICAL PROPERTIES

Physical state: Delayed crystallization, in general with medium or fine granules.

Colour: White, translucent.

Smell: Typical of flower

Taste: characteristic and delicate, slightly acidulated.

MELISSOPALYNOLOGICAL CHARACTERS

Pollen of *Citrus:* above 5%

*Representation class:*I

Absolute quantity of pollinic granules (PK/10 g): below 20,000 (n=37; M=10,000; ds=5,000)

Physico-chemical properties	m	ds	n	Suggested limits
Colour (cm Pfund scale)	1.3	0.6	24	2.7
Specific rotation power $(\alpha)^{20}_{D}$	-14.2	1.9	32	−10+−18
Humidity	17.6	1.3	47	20
HMF (mg/kg)	5.4	4.2	31	15
Diastase (Gothe Scale)	11.4	4.4	19	3+18
pH	3.9	0.1	45	3.7+4.2
Total acidity (meq/kg)	17.3	4.5	28	10+25
Electrical conductivity (10^{-4}S. cm^{-1})	1.7	0.4	40	2.5
Fructose (%)	39.9	2.1	14	34+45
Glucose (%)	32.1	1.3	14	28+36
Glucose + Fructose (%)	72.0	2.6	14	66+77
Sucrose (%)	0.46	1.10	14	2 (0)
Maltose (%)	1.66	0.89	14	4 (0)
Isomaltose (%)	0.95	0.24	14	2 (0)
Melesitose (%)	—	—	14	absent
Fructose/glucose relation	1.24	0.08	14	1.00+1.40
Glucose/water relation	1.85	0.11	14	1.60+2.00

— CHESTNUT MONOFLORAL HONEY —

ORGANOLEPTICAL PROPERTIES

Physical state: liquid in general or with very delayed crystallization.

Colour: amber to dark amber with reddish tinge.

Smell: firm, aromatic.

Taste: strong and persistent with a bitter retrotaste.

MELLISSOPALYNOLOGICAL CHARACTERS

Pollen of *Castanea:* above 90%.

Representation class: III—IV

Absolute quantity of pollenic granules (PK/10 g): from 100,000 to 1,000,000 (n=113; m=300,000; ds=180,000)

Physico-chemical properties	m	ds	n	Suggested limits
Colour (cm. Pfund scale)	9.0	1.9	166	5.5
Specific rotation power $(\alpha)^{20}_{D}$	−16.7	3.4	175	−12
Humidity (%)	17.7	1.2	200	20
HMF (mg/kg)	2.0	1.6	156	10
Diastase (Gotha scale)	24.3	6.0	164	15
pH	5.5	0.5	199	4.8
Total acidity (meq/kg)	15.1	5.0	150	20
Electrical conductivity $(10^{-4}S.cm^{-1})$	14.1	2.6	200	10
Fructose (%)	42.0	2.2	86	37
Glucose (%)	26.4	1.5	86	22+30
Glucose+Fructose (%)	68.4	2.9	86	62+76
Sucrose (%)	0.06	0.10	86	1
Maltose (%)	0.82	0.49	86	2(0)
Isomaltose (%)	2.05	0.83	86	5(0)
Melesitose	can be present but only as traces			
Fructose/glucose relation	1.59	0.11	86	1.35
Glucose/water relation	1.51	0.13	86	1.20+1.80

— EUCALYPTUS MONOFLORAL HONEY —

ORGANOLEPTICAL PROPERTIES

Physical state: crystallized with compact fine or medium granulation

Colour: from light amber to amber, with grey-greenish tinge

Smell: clear and characteristic

Taste: strong and persistent

MELISSOPALYNOLOGICAL CHARACTERS

Eucalyptus pollen: above 90%

Representation class: III

Absolute quantity of pollinic granules (PK/10g):above 80,000 (n=39; m=200,000; ds=100,000)

Physico-chemical properties	m	ds	n	Suggested limits
Colour (Pfund scale)	6.2	1.0	27	4.1+7.1
Specific rotation power $(\alpha)^{20}_{D}$	−13.6	1.8	43	−10+−18
Humidity (%)	16.5	1.0	65	18
HMF (mg/kg)	4.7	3.9	58	15
Diastase (Gothe Scale)	25.8	4.7	46	15
pH	3.9	0.1	55	3.7+4.2
Total acidity (meq/kg)	26.4	5.9	32	15+40
Electrical conductivity (10^{-4}S cm^{-1})	5.1	0.9	65	3.5+7.0
Fructose (%)	38.6	3.3	16	32+45
Glucose(%)	32.8	0.9	16	29+36
Glucose+Fructose(%)	71.4	3.4	16	65+78
Sucrose (%)	1.35	0.64	14	3 (0)
Maltose (%)	0.95	0.51	15	2 (0)
Isomaltose (%)	0.58	0.35	16	2 (0)
Melesitose (%)	—	—	16	absent
Fructose/glucose relation	1.18	0.11	16	1.00+1.40
Glucose/water relation	2.05	0.13	14	1.80+2.25

— THYME HONEY —

ORGANOLEPTICAL PROPERTIES

Physical state: crystallized, in general with medium or fine pasted granulation.
Colour: from light amber to amber
Smell: intense, characteristic for the flower
Taste: aromatic and persistent, pungent in the mouth

MELISSOPALYNOLOGICAL CHARACTERS

Thymus pollen: above 15%
Representation class: I
Absolute quantity of pollenic granules (PK/10g): below 20,000 (n=12; m=12,000; ds=4,000)

Physico- chemical properties	m	ds	n	Suggested limits
Colour (cm Pfund scale)	5.5	1.9	8	3.5+7.1
Specific rotation power $(\alpha)^{20}_{D}$	−20.9	2.0	16	−18
Humidity (%)	17.0	1.5	26	19
HMF (mg/kg)	6.3	2.5	17	15
Diastase (Gothe Scale)	32.6	4.8	12	20
pH	3.8	0.1	23	3.6+4.0
Total acidity (meq/kg)	43.3	7.2	10	30+60
Electrical conductivity (10^{-4}S. cm−1)	3.8	0.5	20	3.2+5.0
Fructose (%)	42.2	1.6	8	37
Glucose (%)	30.5	1.0	8	27+34
Glucose+fructose (%)	72.7	2.0	8	66+77
Sucrose (%)	0.15	0.12	8	1
Maltose (%)	1.71	0.75	8	3 (0)
Isomaltose	0.98	0.41	8	2 (0)
Melesitose (%)	—	—	8	absent
Fructose/glucose relation	1.38	0.06	8	1.20 + 1.60
Glucose/water relation	1.78	0.12	8	1.60+2.00

ANNEX 3

METHODOLOGICAL AIDE MEMOIRE FOR PRACTICAL SENSORIAL ANALYSIS OF HONEYS

I. MATERIAL AND METHODS

A. USED MATERIAL

Appearance evaluation can impose presentation into the original jars, always anonymously delivered, especially for crystallized honeys. But all examinations are accomplished in a glass decanted honey.

This glass has the so-called "balloon" form, hemi-spherical or ovoidal, including a base, a stem and a calix. For unifying reasons we propose as reference "the tasting glass for wines", according to the European standard and described in fascicle A.F.N.O.R., printed in June 1971 under NFV 09 110 reference.

Honey is sampled with the help of a neutral and inodorous *plastic spatula,* "coffee spoon" type, with a total length of minimum 10 cm. and a medium capacity of 2—3 ml.

During tasting and in the interval between two sequences the taster is invited to a "buccal relaxation" by crunching *a juicy apple,* slightly acidulated if possible, but without a piquant taste.

B. AMBIENCE

A hall should be chosen:

— Conveniently sound proof (internal and external noises)

— Without parasitic smells (coming from the building or from outside);

— Where an agreeable temperature is required (above or below 20°C);

— Where hygrometry is not too low (60% RH on average);

— Correctly illuminated, daylight if possible or lacking it an incandescent lighting (luminosity ranged between 200 and 400 lucs);

— With wall surface and paint in a pastel, neutral colour;

— With adequate installations;

a) it should be a *polivalent hall,* with tables covered in a neutral colour, without parasitic reflexes, chairs comfortable enough (not too flexible, not too hard)

b) or a *specialized hall,* used for wines tasting and equipped with a device allowing the isolation of every taster from his neighbour. These halls should have special lighting and every taster use a mini-sink with running water. This arrangement is not indispensable in the sensorial analysis of honeys, but can be useful.

C. TASTERS

Tasters, men and women, are chosen according to their competence and methodological knowledge (previous experience, followed by training courses etc...). They often are professional beekeepers but efforts are needed to recruit from other socioprofessional groups as well, and especially among the consumers. All have to manifest a joint interest into honey evaluation. It is necessary that the chosen people enjoy good physical and intelectual health, be well rested. They have to respect a few elementary hygienic rules and abstain from some habits:

— to not smoke before and during tasting; nor, under the same conditions, drink coffee, tea, alcoholic or based on persistent aromatic constituents beverage. Only clean water can be recommended without reserve;

— to not use perfumes, deodorants or perfumed soaps susceptible to excessively diffuse into the air;

— if possible to work after allowing a long enough time following their meals;

— to not taste more than 15 samples during the same meeting without taking a sufficiently long rest.

Tasters chosen for a competition are grouped into panels, if possible of an impartial number of 3 or 5 people according to availability and the number of samples that have to be evaluated

D. PREPARATION OF SAMPLES

Honey jars that are going to be presented to the tasters are anonymously delivered. From each jar *30 to 40 grames of honey are drawn* when it is crystallized striving to keep the structure of the product intact and to retain the eventual defects observed on the upper part of the jar. Every glass is numbered on its stem and on sample references; it is covered with a plastic pellicle or aluminium foil.

Samples thus prepared are brought into the tasting hall a few hours before tasting to allow honey to get to the hall temperature.

E. PROPOSED WORKING METHOD

Tasting is methodically performed in three successive stages: observation, smelling and tasting.

Observation is done in a first stage on honey contained in its original jar. Then the glass is taken by its stem and the honey sample introduced into it examined. This glass is then raised to the nostrils and smelt. The air is slowly breathed in, long enough and rythmically, till *smells* are perceived. With a spatula 1 to 2 gr. of honey are drawn, put into the mouth and progressively insalivated, kept a few seconds, then projected toward the back of buccal cavity. At this level *aromas* are perceived, their quality and intensity, sapidity of the product, as well as eventual after consuming tastes. A second identical test can be done on crystallized honeys; this time the product is crushed between tongue and palate so that the quality of *texture,* thickness, as well as asperities are examined.

This analysis is transcribed on a file expressed in ordinal values that we have accomplished. This file, as well as the despoiling grid that accompanies it, is presented in Chapter VI (Table 3).

It is completed with recommendations made in the index contained in the second part of this annex.

II. INDEX OF NECESSARY REFERENCES FOR EXAMINATION OF HONEYS LIABLE TO ENTER COMPETITION

Attempt of a basic vocabulary usable in tasting and evaluation of defects and qualities of honeys

A. VISUAL EXAMINATION

COLOUR

All categories of honey:

White — pale yellow — vivid yellow — straw yellow — golden yellow — ambered yellow — orange yellow — reddish — light brown — dark brown — black (the feasible objective measuring of liquid honey with Lovibond comparator: 1 to 14).

Monofloral honeys: (In a more global way)

— insufficiently coloured for denomination
— slight lack of colour for denomination — typical
— normal coloured for denomination — less typical
— slight excess of colour for denomination — atypical
— too coloured for denomination.

CLEARNESS

Clear — slightly thick — important thickness

FLUIDITY AT 20°C

— very fluid (too watery)
— fluid
— dense
— thick
— very compact
— crystallization starts
— crsytallized

CLEANLINESS AND PRESENTATION

— Cleanliness of packing:
— external: clean, soiled
— internal: clean, dirty
— Cleanliness of the surface and product mass:
— lack of foam — slight foam — thick foam
— clean — some residue — numerous residues (of endogene or exogene origin)
— Nature and quality of packing:
— compulsorily accepted according to food standards and appropriate for honey storage (glass jars, waxed cardboard, plastics special for containing food, plastic or galvanized buckets...)
— ad hoc or tight lids
— Quality of labels:
— appropriate label, dirty, soiled with honey, obliquely, badly glued

HOMOGENEITY OF THE ENSEMBLE

— For liquid or crystallized honeys:
— very homogene — homogene — slight presence of differently coloured strata — very visible strata
— air bubbles observed on the surface in the liquid honey mass
— Only in crystallized honeys (crystallization accidents and post-crystallization ones):
— incomplete, fractioned crystallization — phase separation (fine liquid layer on the surface, thick liquid layer floating on the surface)
— marmorean — white traces — arborescent: slight, heavy, very heavy.

CRYSTALLIZATION

— Origin:
— fine — medium — rough — agglomerated...
— Crystals form:
— round, angular...
— Structure:
— compact — cohesive — less cohesive — pasted — soft — stable — unstable.

DIVERSE
— Fermentation:
— absent
— index (slight release of CO_2, abundant CO_2 release)

B. **OLFACTORY EXAMINATION OF SMELLS** (direct nasal way)

STRENGTH
— null — very weak — slightly weak — medium — strong enough — very strong.

GENERAL CHARACTERS
— vegetal — floral — with fruit smell — animal
— great fineness — fine — fine enough — somehow — common — vulgar — rough...
— delicate — easy — subtle — elegant — sweet — strong — very intense — heavy...

ELEMENTARY SMELLS
— characters of floral honey or honeydew honey of: acacia — orange — lavender — rosemary — rape — sunflower — dandelion — alfalfa — lime — fir tree — chestnut — Erica heath — Calluna heath — etc...
— characters of type fruit smell recalling: apples, grapes, figs etc...
— characters of vegetal type recalling: malt — resin — mentholated balm — cocoa — nuts — acroleine — straws — hay — grass — vanilla...
— animal connotation: leather — musk

DEFECTS
— Honeys of all categories:
— smells of smoke, of old sackcloth;
— smells of phenol, of nitrobenzene
— smells of burnt honey (baked)
— fermentation smells
— other foreign smells
— Monofloral honeys:
— smell of essence strange to certain types of honey
— specific smells very weakly perceived

C. GUSTATORY EXAMINATION AROMA (retronasal way)

STRENGTH

— null — very weak — weak — slightly weak — medium — strong enough — strong — very strong

PERSISTENCE (PAI)

— very short — short — medium — long — very long

GENERAL CHARACTERS

— vegetal — floral — with fruit aroma — semirheumatic
— great fineness — fine — fine enough — somehow — common
— vulgar — rough
— delicate — easy — subtle — elegant — strong — heavy

ELEMENTARY AROMAS

— characters of floral or honeydew honey of: acacia — orange — lavender — rosemary — clover — rape — sunflower — dandelion — alfalfa — lime — fir tree — chestnut — Erica heath — Calluna heath etc...

— characters of type fruit aroma recalling: apples — grapes — almonds — figs — etc...

— characters of vegetal type recalling: malt — resin — balm — menthol — cocoa — nuts — acroleine — sweet wood — pollen — wood — straws — dried hay — grass —tobacco — vanilla...

DEFECTS

— honeys of all categories:
— phenol smell — bitter almond — carbonil (hive paint)
— aroma of burnt honey, slightly sour (fermentation)
— different strange aromas...
— Monofloral honeys:
— aroma strange to certain type of honey
— specific aroma perceived at a very weak level

STRICT SAPIDITY

ACIDITY

— null — weak — strong enough — sour (fermentation)

BITTERNESS

— null — weak — strong — very strong

SALINITY

— null — weak

SUCROSITY
— medium — strong — very strong

DIFFERENT CHEMICAL SENSATIONS (after consuming taste)

ASTRINGENCY
— null — weak — medium — strong enough — strong

BITTERNESS — HOTNESS
— presence — absence

TACTILE SENSATIONS
LIQUID HONEY OR GOING TO CRYSTALLIZE
— very fluid — insipient — pasted — very pasted

CRYSTALLIZED HONEY
— Crystallization type:
— very fine — fine — medium — rough enough — very rough
— the edifice crystalline structure:
— flabby and lacking cohesion — insipient and perfectly pasted (cremed honey) — firm enough — firm — very firm
— Nature and quality of formed crystals:
— agglomerated — spherical — angular — pointed — as gravel — floury etc...
— fondant — dried — crunchy

LIQUID HONEYS AND CRYSTALLIZED HONEYS
— pleasant — pleasant enough — mediocre — unpleasant (affective judgement following the mecanical evaluation of honey into the mouth: velvety — normal — irritating)

D. JUDGEMENT PER ENSEMBLE

GENERAL JUDGEMENT
— fresh — young — old — too old — degraded

FINAL GLOBAL JUDGEMENT
— All categories:
— very original — original — satisfactory — banal — very common — defective enough — defective
— Monofloral honeys:
— correspond to denomination
— limit for denomination
— does not correspond to denomination

Here are a few examples of logical evaluation — according to the recognised defects and qualities of honeys undertaking analysis

To remind that within the proposed grid, defects are judged in intensity (weak, strong enough, strong) and that this way of evaluation is entirely valid for any other conventional notation systems.

A. **FOR VISUAL DEFECTS**

a) *For all crystallized or liquid honeys*

— Rough, incomplete, fractioned crystallizations or phase separation are in general "strong enough" or "strong" defects.

— A thick honey that crystallizes can be penalized through a "weak" defect for its passing instability. On the contrary, if this type of honey does not crystallize in its natural state, the respective defect will be judged "strong" and can lead to elimination.

— A homogenous crystallization, but with perceptible granules under tongue will be judged as a "weak" defect.

— Post—crystallization defects, white stains, marmorean traces on the jar walls constitute 'weak' or 'strong enough' defects, depending on their importance.

— Impurities present in a suspended state in honey and on the jar pertain to defects whose intensity vary according to the origin and number of polluting elements. The same thing is valid in connection with the air bubbles observed above and in the honey mass.

— A honey put into *a container that does not answer* hygienic requirements or respect current legislation should be penalized as a strong and eliminatory defect.

— Excessive fluidity of a liquid or crystallized honey (flabby and lacking cohesion product) suggests a "strong" defect taking into account the potential risks of phase separation or fermentation. A more or less important emission of carbonic gas, characterized by big bubbles that break into the walls and on the upper part of the jar always constitute a "strong" and eliminatory defect (confirmation is needed by olfactory/gustatory examination).

— For all other small defects, directly perceived in honey contained in its original packing or after decantation into the observation glass, a weak or strong enough defect can be noted in general when more small defects are gathered.

b) *For all monofloral honeys and eventually for a definite type and for which we possess references on polifloral honeys*

— The intensity of the analyzed colour according to the official Pfund index.

REMARK: If the intensity of colour goes above the maximum level stipulated for this honey type, it is a 'strong' defect that is eliminatory from every competition, irrespective of the marks obtained in other fields. If the registered colour tends towards the acceptability

limit honey will be penalized with a "strong enough" or "strong" defect but will not be eliminated.

B. FOR THE OLFACTORY DEFECTS

a) *For all categories of honey*

— A parasitic smell strange to honey (smoke, phenol, etc.) constitutes a defect "strong" in general (depending on the intensity and origin of polluting factors).

A smell originating in physical, chemical or biological modifications ocurring in honey and consecutive to heating, aging or fermentation is always considered as a "strong" defect.

b) *For monofloral honeys*

— When the specific smell of a honey is not sufficiently felt (level that has to be established according to the monofloral reference product), the respective defect is 'strong enough' or 'strong'.

—When the smell type of the reference honey is mixed with a smell of different essence, this defect is by force considered 'strong'.

C. FOR GUSTATORY DEFECTS

a) For all categories of honey

Defective aromas, flavour or taste due to substances forgein to honey or that have appeared in it following chemical or biological changes of the product: bitter smoke after consuming taste, acidity due to fermentation, caramel taste, consecutive to heating etc. Bitterness (only if this feature is not specific to the honey type). These are in general 'strong' defects.

b) For monofloral honeys:

—Absence or weak presence of a specific aroma to the respective honey (degree that has to be established according to reference samples) or perception of aromas strange to the honey type also constitute "strong" defects.

REMARK: If the honey smell and taste are due to foreign substances (or natural but of a different essence from the one judged for monofloral honeys) and if these substances mask or interfere with the main specific aromatic compounds of the product, this honey is eliminated from the competition irrespective of the marks got in other fields.

If the smell and aroma allow the identification of a not too heated honey or which suffered a fermentation start, the product will also be removed from competition.

D. FOR TACTILE DEFECTS

— Crystallization defects are the same time visual and tactile; they will be judged for their bigger or smaller intensity. Such a honey with rough crystallization that irritates the palate and the throat, will be marked as 'strong' defect.

— A honey with fine granulation, but whose structure is too cohesive that causes difficulties in decantation will be penalized as a 'weak' or 'strong enough' defect.

E. FOR QUALITY EVALUATION

In the preamble it should be stressed that a honey which does not present defects in its category already proves to be a good qualitative product. Quality will be judged at the level of *1. appearance characters;* of *olfactory characters,*of *gustatory characters* and finally of a few *composition criteria.*

1. Appearance characters: Perfectely liquid or finely crystallized honeys, homogene, not too coagulated or even creamed are all products with a good presentation. In this evaluation of quality presentation can be included, its packing, and the label...

2. Olfactory characters: The intensity of smell associated to its character will be evaluated (fine-heavy), with identification (floral, with fruit aroma...) that will be eventually done and, finally, with pleasure produced by the product (this latest trait should be moderate because it is subjective by force).

3. *Gustatory characters:* At this level, the judgement and classification of honeys is done first of all according to the fineness and strength of the aromas, then according to their persistence at the back of the mouth after the product is ingested; this aromatic persistence can be measured in seconds. Intensity of sweet savour can be appreciated too, always very raised, but varying depending on the honey type. Different gustatory qualities can be judged, as for example a more or less pronounced bitter flavour, typical after consuming taste. To note that that when these different sensation concord with the recognized gustatory standards for a given honey type, judgement made by the taster will be positive and retained as a plus to quality, even if the respective sensations is not agreeable to the taster.

An important remark: in order to judge the gustatory quality of a honey, the perfect knowledge of the reference product is needed. The main olfactory and gustatory characters have to be especially well perceived, identified and memorized. When *monofloral honeys* are judged this reference can be materialized by reference samples, analyzed and recognized of pure origin. Also for *well-known polifloral honeys* identified reference that poses a "trade mark" is needed. Regarding *polifloral honeys without precise reference* there is of cour-

se no witness. In this case, when these type of honeys are presented in competition it is possible to do a first sorting out in order to compare only products with close aromatic intensity. The most simple sorting constitutes in separation of these honeys into 2 or 3 categories of different colours with reference to the official Pfund index with, for example, clear honeys, ambered honeys and dark coloured honeys. The evaluation of the perceived sensations quality in this aroma field will have a less sentimental value for these polifloral honeys, but should always be level-headed regarding the evaluation of defects.

Finally, the tactile sensation is linked to the global mechanical appreciation on a sample of honey put into the mouth. An easily decanting honey does not flow too easily, is sweet, velvety on the palate and well insalivated and will get an excellent mark at this level.

To remind at last that the honey samples undergoing tasting have to be anonymously presented. They will be brought to the panel into jars, for a first visual examination (producer's coordinates will be certainly covered), then the analysis is continued on a sample put into a stemmed glass for proper tasting.

The final judgement of defects and qualities will be done and transcribed in terms of grades after every honey analysis.

Defects are added and their incidence is objective. Quality is judged according to the criteria that tend towards objectivity, still without leaving aside, especially for monofloral honeys, fully subjective individual factors that are linked to "preference".

It is therefore a *level-headed judgement that done by the taster who should never forget his mediating role.* He is the *judge of pleasure and quality of sensations the uninspired consumers of honey are going to feel;* and, in this quality, he cannot wholly abstain from every olfactive appreciation.

In order to strenghthen the evaluation of the sensorial quality of a honey and prepare the tasting work, two very important analytical factors have to be taken into consideration:

— water content*

— HMF content

a) *Water content (expressed in %)*

1) For values below 18%, the term is not retained and its notation is freely done according to the normal criteria above described.

2) *For values ranged between 18 and 19%* the taster is informed about the degree of water content and, following the sensorial evaluation will penalize honey (1 to 2 disqualification degrees depending on the discovered percentage).

3) *For values bigger than 19%* honey is not admitted into competition.

N.B. *In an exceptional way,* for honeys coming from *heath (Calluna vulgaris)* this norm is raised to:

a.1. (19.5%); a.2. (19.6% and 21%); above this level honey is disqualified.

b) *HMF content* (expressed in mg/kg of honey)

1)*For values less than 10 mg,* the precise content is not communicated to the taster and its grading remains free.

2) *Between 10 and 15 mg* the precise term is communicated to the taster who will keep it in mind and tax honey with a defect (1 to 2 penalization grades following the anounced percentage).

3) *Above 15 mg* honey is not admitted into competition.

N. B. At least an *exception* can be foreseen for honeys produced from *white heath* (Erica arborea) for which the grading is raised at:

b.1. (15 mg); b.2. (15 to 20 mg); beyond that honey is disqualified.

Other analytical controls previous to tasting are relatively indispensible for the quality of honeys presented into competition.

a) *For all categories of honey and especially for honeydew honeys*

1. — Electrical conductibility*
2. — pH*
3. — colour (Pfund index)*

b) *For monofloral honeys*

Results of these analysis will allow for example:

— *for polifloral honeys:* to make a better classification into categories before facing different panels or, pure and simple, to separate flower honeys from different honeydew honeys.

— *for monofloral honeys:* to eliminate before tasting honeys that do not evidently correspond to the denomination (colour excess or in a more general way, an incorrect pollenic analysis).

Speaking of *pollenic analysis* honey will not be admitted into competition in case the laboratory draws the conclusion that it is a striking discrepancy between the proposed denomination and the result of the respective analysis. All other samples in a case limit will still undertake the tasters' judgement without being informed about the performed analysis.

Other analysis and especially sachharose analysis remain optional for the competition. It may present interest to do them; but the obtained results are rarely determining although they can help to characterize the monofloral honeys. Yet in certain cases, they can prove indispensable when one speaks about, for example, the control of an eventually excessive saccharose (added or natural). Of course, inthis event the illegal sample will be rejected.

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* *All these analyses are described into specialized studies and especially in the official methods contained into Codex Alimentarius.*

ANNEX 4

VOCABULARY OF THE SENSORIAL ANALYSIS

We include a few definitions of terms used in the sensorial analysis vocabulary. File AFNOR NF V 00-150 we referred to give the ensemble of the used terms:

GENERAL TERMINOLOGY

Sensorial analysis — Examination of organoleptical properties of a product through sense organs.

Sensorial — Relative to the use of sense organs.

Organoleptical — Qualifies a property of a product perceptible through sense organs.

Subject — Every person taking part in a sensorial test.

Panel — Group of chosen subjects to participate in a sensorial test.

Taster — Subject, qualified or expert who evaluate the organoleptical properties of a food product, mainly with the help of the mouth.

Tasting — Sensorial evaluation of a food product in the mouth.

Property — perceptible characteristic

Acceptability — state of a product favourably received by a certain person or a certain population, according to its organoleptical properties.

Appetite — Psychological and/or physiological state manifested by craving for food.

Hedonistic — refers to a pleasant or unpleasant character.

TERMINOLOGY RELATIVE TO PHYSIOLOGY

Receptor — Specialized part of a sensorial organ that responds to a certain stimuli type.

Stimuli — that can excite a receptor

Perception — to get acquainted with the effects of simple and complex sensorial stimuli.

Taste — a) Sense of taste

TERMINOLOGY RELATIVE TO ORGANOLEPTICAL PROPERTIES

Acid (savour):

a) qualifies the elementary flavour caused by diluted watery solutions of the majority of the acid bodies (for example citric, tartric acids);

b) qualifies the organoleptical property of pure bodies or mixed whose tasting provokes this flavour.

Acidulated — Qualifies a product with a slightly acid flavour.

Sour:

a) qualifies the complex olfacto-gustatory sensations due in general to the presence of acid organical compounds;

b) qualifies the property of pure or mixed substances that produce this sensation.

Note: To not use it as synonymous to the acid elementary flavour.

Bitter flavour:

a) qualifies the elementary flavour induced by diluted watery solutions of different substances as quinine, other alkaloids and caffeine

b) qualifies the organoleptical property of pure bodies or mixtures whose tasting generates this flavour.

Salty (flavour):

a) qualifies the elementary flavour induced by watery solutions of different substances as sodium chlorine;

b) qualifies the organoleptical property of pure bodies or mixture whose tasting generates this flavour.

Sweet (flavour):

a) qualifies the elementary flavour induced by watery solutions of different substances as sucrose;

b) qualifies the organoleptical property of pure bodies or mixture whose tasting generate this flavour.

Sucrosity see sweet b.

Alkaline:

a) qualifies the complex sensation generated into the mouth by watery solutions of certain basic substances as hydrogencarbonate of sodium (bicarbonate);

b) qualifies the organoleptical property of pure bodies or mixture whose tasting leads to this sensation.

Properties of the products that generate the gustatory sensations

Note: It should not be used into a more general sense to designate gustatory, olfactory and common chemical sensitivity sensations, that are known under the name of aroma (flavour).

If in the usual language it happens that this term is used in this sense it has always to be accompanied by a qualification. For example: musty taste, raspberry taste, taste of cork.

Gustatory — that refers to the sense of taste.

Tasting — function of the gustatory apparatus.

Olfactory — relative to smell.

To smell — (active sense applied to the smell) synonymous to: to smell — to perceive a smell through the olfactory organ.

Acuity — Aptitude of the sensorial organs to perceive, identify and/or differentiate qualitatively and/or quantitatively one or more stimuli.

Note: This term has to be differentiated by the term "sensitivity" in French, that does not refer to the aptitude level.

Intensity — Grade (magnitude) of the perceived sensation

Sensorial tiredness — Form of sensorial adaptation corresponding to an acuity loss.

Antagonism — Concurring action of two or more stimuli whose association generates a level of sensation inferior to the excepted one from the superposition of the effects of every stimuli isolately judged.

Synergism — Concurring action of two or more stimuli whose association generates a level of sensation superior to the expected one from the simple addition of every stimuli effects isolately considered.

Masking — Lowering intensity or modification of the quality of perception of a stimuli through simultaneous action of another stimuli or adding a coresponding substance.

Threshold — (term that should not be used without a qualification).

Appearance threshold; detection threshold; perception threshold

Minimal value of a sensorial stimuli allowing the identification of the perceived sensations.

Identification threshold — Recognition threshold — Minimal value of the sensorial stimuli allowing the identification of the perceived sensation.

Aroma (flavour) (aroma and taste at the same time)

a) Complex ensemble of olfactory and gustatory properties perceived during tasting; can be influenced by tactile, termic, algic and quinestezic properties.

b) Complex ensemble of sensations generated by these properties.

Flavour:

a) organoleptical property perceptible by the gustatory organ when it is stimulated by certain soluble substances;

b) sensation generated by this property.

Sapid: (tasty, full of flavour) — qualifies a product full of taste and flavour.

Insipid: qualifies a product that has no aroma (flavour).

Tasteless: qualifies a product that has little aroma (and taste).

Buccal tactile sensations: — tactile sensations perceived in the interior of the mouth.

After consuming taste ((arrière-goût) — Olfacto-gustatory sensation that appears after the elimination of the product and differs from sensations perceived when the product was in the mouth.

Persistency — Remanent olfacto-gustatory sensation resembling to the one perceived when the product was in the mouth and its duration cannot be measured.

Aroma:

a) Perceptible organoleptical property by the olfactory organ on the retronasal way during tasting;

b) Sensation generated by this property;

c) Ensemble of substances present into a food and that generates olfactory sensations during tasting.

Smell:

a) perceptible organoleptical property by the olfactory organ "sniffing" certain volatile substances;

b) sensation induced by this property.

Aspect — Visible properties.

Texture — Ensemble of reological and of structural (geometrical and of surface) properties of a certain food product, perceptible by the mechano-receptors, tactile receptors and, eventually, by the visual and auditory receptors.

Consistency — Ensemble of sensations following the mechanical stimulation of the receptors and of tactile receptors, especially in the buccal zone and that vary with the texture of the product.

Tough — A special texture, qualifies a product that offers a substantial resistence to deformation or breaking.

Firm — A texture characteristic; qualifies a product that offers a moderate resistence to breaking during mastication.

Soft — A texture characteristic, qualifies a product that offers a weak resistence to deformation during mastication.

Delicate — A texture characteristic, qualifies a product that offers a weak resistence to breaking during mastication.

Terminology relative to methods

Analysis test — Part of the test sample that is directly evaluated by the subject.

Reference element — Chosen value (of one or more properties of a product) in relation to which samples are evaluated.

Reference sample — Sample of the tested product constituting the reference element with which the other samples are compared.

Comparing test through pairs — Method in which stimuli are present in pairs to be compared on the basis of a few well defined criteria.

Triangular test — Differentiation method including three codi-

fied samples simultaneously presented, two of them being identical. Subject requested to point out the different sample.

Twos-Threes test — Differentiation method in which the reference sample is presented first; it is followed by two samples out of which one is identical to the reference sample that the subject is requested to identify.

Test "A" or "different from A" (test on an unique stimuli) — test in which a series of sample that could be "A" samples or not, is presented to the subject after he has been taught to recognize sample "A". Subject is then requested to point out if the samples are "A" or "non A".

Classification — Method in which a series of samples is classified in order of intensity or grade into a precise property. This method is ordinal, without trying to give the size of differences.

Objective method — Method in which the effects of personal influence are reduced to minimum.

Subjective method — Method in which the effects of personal influence are not reduced to minimum.

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