The First International Acoustical Conference

THERE is scarcely any subject which, during the last few years, has assumed greater commercial and social significance than acoustics. Alongside has come the steady growth of noise—that is, unwanted sound—which in its many aspects is beginning to stir the consciousness of the public to such an extent that it is demanding measures for relief in the more outstanding cases. Acoustics has furthermore developed a large specialized terminology, and the need for agreed measuring units and standards has become more and more pressing.

In Great Britain such questions have been dealt with by a British National Committee under the auspices of the British Standards Institution. Under the chairmanship of Dr. G. W. C. Kaye, this Committee has developed and classified an extensive glossary of acoustical terms*, particular attention being given to units and standards, among them the scales and units of loudness and energy-level. As regards these latter, which are of especial importance, considerable divergencies have unfortunately prevailed in the practices of different countries, not only as regards the scales, units and zeros of the standard reference tones, but also in the listening techniques and phraseology employed. In its work, the British Committee kept in mind the desirability of eventual international agreement in such matters and to this end set up specifications dealing with the standard reference sound (a sinusoidal plane progressive wave of a frequency of 1000 cycles per second), and the arbitrary zero of reference (0.0002 dyne per sq. cm.). The "phon" (a name we owe to Barkhausen) was adopted as the unit in the subjective scale of equivalent loudness, while the use of the "decibel" (a name which originated in America) was restricted to the scale of the associated energy or pressure level.

In July of this year, the first international conference on acoustics was summoned in Paris under the auspices of the International Electrotechnical Commission (I.E.C.), some sixty delegates from

thirteen countries assembling under the presidency of M. Duval, president of the French Electrotechnical Committee. Substantial agreement was reached in the several sections set up to deal with vocabulary, fundamental units and methods of measurement, electro-acoustics, and noise abatement. Chief interest centred in the questions of fundamental units and methods of measurement, and it is satisfactory to learn that the proposals eventually adopted are in complete agreement with the specifications submitted by the British delegation under the chairmanship of Dr. Kaye. The "phon" and the "decibel" are accordingly accepted as international units, so that an important contribution to international acoustical measurements has been achieved. Particular mention should be made of the helpful and conciliatory outlook of the United States and German delegations, of whom Dr. Harvey Fletcher and Dr. Grutzmacher were the respective chairmen.

An inquiry into the present position of objective noise meters indicated that while great progress had been made, there was not enough experience available to approve at the present juncture the specification and standardization of a 'universal' noise meter which will measure on the phon scale any and every type of sound. Other points dealt with included the standardization of methods of testing microphones and loud-speakers, the different procedures adopted in various countries for measuring acoustic absorption coefficients by the reverberation method, the methods used to investigate the transmission of air-borne and impact sounds in buildings, and the steps taken in different countries for reducing noise.

The pronounced success of the Conference owed much to the valuable preparatory work of the I.E.C. and the co-operation of M. Valensi, secretary of the Comité Consultatif International Téléphonique. It was agreed at the final plenary meeting that the work of future conferences should be administered by the Federation of National Standardising Bodies known as the International Standards Association, the I.E.C. concurring and actively collaborating.

* "British Standard Glossary of Acoustical Terms and Definitions" (London: British Standards Institution, 1936) 3s. 6d. net.

Concentration of Solutes in Vacuolar and Cytoplasmic Saps

By Dr. E. Phillis and Dr. T. G. Mason, F.R.S.

IF 25–30 gm. of mature leaves of the cotton plant are rolled up, wrapped in cloth, the wad placed between two disks about 2 in. in diameter and the whole put in the jaws of a small vice, sap is expressed on the application of pressure. As the sap flows out of the wad, much of the leaf is squeezed out from between the disks. To obtain more sap, the tissue must be collected into a ball and again wrapped up in the cloth. On the application of pressure, sap is again expressed. This process can be repeated three or four times; but a point is reached when even

under the greatest pressures that can be obtained in the vice, the yield of sap amounts to only a few drops. If now the residue from which sap has been expressed is frozen at -16°C . and then thawed, much more sap can be obtained on the application of very small pressures.

It was observed by Dixon and Atkins¹ that the concentration of solutes increased in successive fractions. They also discovered that preliminary treatment of the leaf by freezing or by exposure to anaesthetics greatly increased the concentration of

solutes over that in sap expressed from untreated tissue. Typical results from our own experiments for calcium, magnesium and potassium are shown in Table 1.

TABLE 1. SAP EXPRESSED IN VICE.

		No. of fractions			Frozen residue
		1	2	3	
ml. sap from 100 gm. fresh wt.		11.2	11.4	12.7	28.6
Concentration (mgm. per 100 gm. water)	Calcium	490	525	568	848
	Magnesium	54.4	57.3	61.2	99.7
	Potassium	201	218	238	264

It will be seen that much sap was released and that there was a marked increase in the concentration of solutes as a result of freezing the residue. The usual explanation (Walter²) for the increase in concentration in successive fractions is that pressure has two effects, one being the expression of water through the cytoplasm and its membranes, solutes being retained in the vacuole, and the other the bursting of cells and consequent liberation of vacuolar solution. The change in concentration in successive fractions is assumed, therefore, to be due to filtration of water and concentration of the vacuolar solution. The increased concentration resulting from freezing is generally interpreted as due to the breakdown of impermeable membranes and the release of the vacuolar sap. It is very commonly assumed by botanists (Scarth and Levitt³) that the cytoplasm in mature leaves contributes but little sap and that the bulk of the sap expressed even from previously frozen tissue comes from the vacuole. Perhaps it is also true that many botanists still believe that the continuous phase of cytoplasm is water (cf. Stiles⁴), and that some of this water may be expressed, particularly after coagulation of the cytoplasm which is assumed to occur as a result of freezing.

Somewhat to our surprise, we have observed that if leaves are carefully placed one on top of another between the relatively large plates of a hydraulic press, the concentration of sap in successive fractions does not necessarily increase as the pressure is increased. The concentrations are also found to be lower than when leaves are pressed in the usual way in the vice. In the hydraulic press, using carefully arranged leaves, they are not squeezed out from between the plates, and the shearing forces that arise in the vice, as leaves are redistributed in the wad as its shape is changed, are negligible or absent. The presence or absence of shearing forces appears to be crucial. The results for a duplicate sample of leaves to that used in Table 1 are shown in Table 2.

TABLE 2. SAP EXPRESSED BY HYDRAULIC PRESS.

		No. of fractions			Frozen residue
		1	2	3	
Pressure (lb. per sq. in.)		6,000	10,000	16,000	16,000
ml. sap from 100 gm. fresh wt.		13.1	13.5	11.6	28.5
Concentration (mgm. per 100 gm. water)	Calcium	420	414	424	886
	Magnesium	46.9	44.5	46.5	107.2
	Potassium	162	181	176	253

It will be seen that there is again a great increase in concentration when the residue is frozen and pressure applied. Of outstanding importance is the fact that the concentration remains nearly constant and does not rise as the pressure is increased. There is thus no support for the view that water is filtered under pressure through the cytoplasm. Other causes for the increase in concentration in the vice must therefore be sought. It will be noticed that even the first fractions in the vice exceeded those in the hydraulic press. If the results are graphed, it will be seen that the curves for the two methods of expressing sap diverge from a common origin. It is noteworthy that even under pressures so high as 16,000 lb. per sq. inch, only approximately half the sap was expressed.

The meagre proportion of the total sap present in the leaf that can be expressed by these high pressures does not indicate that the continuous phase of cytoplasm can be water, as is generally assumed, for as much water can be expressed from a gelatin gel under a pressure of 2,000 lb. per sq. inch as is liberated⁵ by freezing at -20°C . It must be borne in mind that nearly half the volume of the mesophyll cells in cotton, excluding the cells' walls, consists of cytoplasm. This is contrary to what is usually believed to be the case (cf. Stiles⁴); but Iljin's⁶ measurements show that cotton is by no means exceptional in this respect. It would seem that the continuous phase of active cytoplasm, as Lepeschkin⁷ suggests, is a liquid, composed probably of proteins, lipoids and water. This liquid, as we have previously⁸ suggested, would appear to have solubilities and diffusion constants quite different from those of water, and to be dependent for its origin and maintenance on respiratory energy. With such a concept of the composition of the continuous phase of cytoplasm, the results already described would be explained as follows.

When the leaf is pressed in the hydraulic press, the vacuolar sap escapes through fissures in the cytoplasm. The continuous phase of the cytoplasm, for which Lepeschkin has proposed the term 'vitaid', is not decomposed by this direct pressure into its component parts. In the vice, on the other hand, shearing forces are operating. We thus assume that the 'vitaid' molecule is decomposed by comparatively small shearing forces though able to withstand direct pressures of considerable magnitude. Thus in the vice a gradual decomposition of the 'vitaid' molecule occurs. It is broken up into proteins, lipoids and water, while the solutes which were in solution in it are now dissolved in the water and escape with the vacuolar sap, which in the leaf of the cotton plant is considerably more dilute than the sap that is produced as a result of the decomposition of the 'vitaid' liquid. The great increase in concentration and the large amount of sap produced when the residue from the hydraulic press is frozen is due to the decomposition of the 'vitaid' liquid by the shearing forces that arise as a result of the formation, and perhaps the disappearance, of ice in the vacuole and the intercellular spaces.

Some confirmation of this hypothesis is furnished by the following experiment, the results of which are shown in Table 3. If the residue from the hydraulic press from which all the sap available at a pressure of 14,000 lb. per sq. inch has already been expressed, is divided into two portions, one of which is frozen and one of which is gently rubbed between the fingers and thumb, it will then be found that further

sap can be expressed from each portion merely by squeezing in the hand. The volume obtained after rubbing, as might be expected, is slightly less than that after freezing, for the shearing is less thorough. The concentrations in the two residue saps were approximately equal in this experiment, although in other experiments, those in the finger-rubbed fractions have been slightly below those in the frozen fractions. The maximum pressures used give no indication of the ease of expression of sap. From the fresh tissue, no sap was obtained below a dial reading of 4,000 lb. per sq. inch hydraulic pressure, while with both the residues, most of the sap was expressed before the needle left the zero mark.

TABLE 3. EFFECT OF PREVIOUS TREATMENT OF RESIDUE ON SAP OBTAINABLE UNDER PRESSURE.

	Fresh leaves	Treatment of residue	
		Finger-rubbed	Frozen
Maximum pressure (lb. per sq. inch)	14,000	14,000	14,000
gm. sap from 100 gm. fresh weight	24.4	30.9	36.7

		Fresh (hydraulic pressing)	Residue treatment	
			Finger-rubbed	Frozen
Concentration (mgm. per 100 gm. water)	Calcium	266	718	712
	Magnesium	44.0	104.7	106.6
	Potassium	275	599	604

It is interesting to note that Audus⁹ has found that rubbing a leaf on both sides with a finger stall or merely bending the leaf increases respiration 2-3 fold.

If we are correct in the interpretation of the results, we can form *approximate* estimates of the

concentrations of solutes in the vacuole and cytoplasm respectively. The vacuolar estimate is obtained from the lowest concentration obtainable by direct pressing. This may be an over-estimate, for slight shearing forces will cause some cytoplasmic decomposition; for example, when brittle leaves are pressed in the hydraulic press, successive fractions of sap show diminishing concentration, due, we believe, to shearing forces developed in the leaf mass during the initial stages of compression. The action of such shearing forces is associated with the presence of chloroplasts in the expressed sap. If the vacuolar sap could be completely expressed the residue should, on decomposition, yield a sap representative of the cytoplasm, but incomplete vacuolar pressing will cause dilution of the cytoplasmic sap and an under-estimate of its concentration. In the leaves used in the experiment just described, the concentration in the cytoplasm must have been more than double that in the vacuole.

Methods used for the extraction of sap invariably include some process which we believe leads to destruction of the 'vitaid'. These processes include boiling², freezing, grinding¹⁰ and treatment with anaesthetics¹¹. All saps obtained by these processes are, therefore, mixtures of vacuolar sap with that produced on decomposition of the vitaid. It will be necessary in the future, we think, to distinguish between the true (vacuolar) sap and that derived from the destruction of the cytoplasm.

¹ Dixon, H. H., and Atkins, W. R. G., *Proc. Roy. Soc. Dub.*, **18**, 422 (1913).

² Walter, H., *Ber. deut. bot. Ges.*, **46**, 539 (1938).

³ Scarth, G. W., and Levitt, J., *Plant Physiol.*, **12**, 51 (1937).

⁴ Stiles, W., "Introduction to Principles of Plant Physiology". (London, 1936).

⁵ Jordan, Lloyd D., and Moran, T., *NATURE*, **132**, 515 (1933).

⁶ Iljin, W. S., *Bull. de l'assoc. Russe pour les recherches scientifiques à Prague*, **1** (VI). Sec. des sciences naturelles et mathématiques. No. 4 (1934).

⁷ Lepeschkin, W. W., *Biodynamica*, **19** (1936).

⁸ Mason, T. G., and Phillis, E., *Bot. Rev.*, **3**, 47 (1937).

⁹ Audus, L. J., *New Phyt.*, **34**, 386 (1935).

¹⁰ Sayre, J. D., and Morris, V. H., *Plant Physiol.*, **7**, 261 (1932).

¹¹ Chibnall, A. C., *J. Biol. Chem.*, **55**, 333 (1923).

International Congress for Short Waves in Physics, Biology and Medicine, Vienna*

PROF. H. THIRRING, in an address made during the opening ceremony of the Short Wave Congress held in Vienna on July 12-17, referred to the many fields of application of Hertzian waves in research, medicine and radio technology. These fields are to some extent interdependent, and there are in particular medical and biophysical problems which require the collaboration of biologists, physicists and radio-engineers if they are to be solved satisfactorily. Thirring pointed specially to the urgent problem of dosage measurement in short wave therapy and to the fundamental scientific question of the mode of biological action of short waves: specific or thermal. These problems occupied a prominent position in the Congress, and, together with purely physical papers, will form the substance of the

* Internationaler Kongress für Kurzwellen in Physik, Biologie und Medizin. Referate und Mitteilungen. (Wien: Brüder Hollinek, 1937).

present report; the review articles in the various sections and the fifty or so papers in the medical section will not be dealt with. (Number in brackets in each heading indicates the number of papers presented.)

(1) *Production of ultra-short waves* (11). Most of the papers dealt with retarding field or magnetron circuits devised for production of the shortest waves; the most interesting perhaps was the 14 cm. wave retarding field generator with resonant cavity as frequency stabilizer, demonstrated by Dällenbach, Alderding and Kleinstaub. The demonstration showed the remarkable frequency stability attained and the modulation of the 14 cm. wave. Another retarding field system was described by Meng and Potapenko, who have constructed exceedingly symmetrical micro-tubes for high-order oscillations of wave-length ~ 1 cm. McArthur described a new