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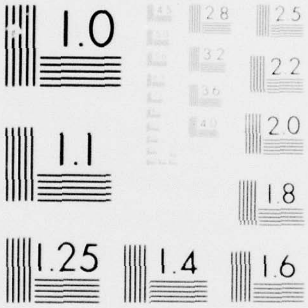

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EUROPEAN SCIENTIFIC NOTES

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EUROPEAN SCIENTIFIC NOTES

1 May 1952 Vol. 6, No. 9

SYMPOSIUM ON TELEVISION

From 28 April to 3 May a convention was held in London on "The British Contribution to Television." Eighty-three papers were read at a series of ten sessions covering the history of television, the engineering aspects of program production, television broadcasting stations, wave propagation, relay links, industrial applications, receiver components, receiver design, and communication theory. The papers and discussion from the convention are to be printed in issues 17-20 of the Proceedings of the Institution of Electrical Engineers and will appear later this year. Additional information will be found in Technical Report ONRL-43-52 obtainable from the Technical Information Office, Code 250, Office of Naval Research, Washington 25, D.C.

New Klystrons

Papers describing new klystrons were read by engineers from Standard Telephones and Cables, Ltd., and E.M.I. Research Laboratories, Ltd. Mr. A.H. Beck and Mr. A.B. Cutting of STC described a reflex klystron, type CV2187, designed for use in television relay links operating in the frequency range 3,600 to 4,200 Mc. The tube has been designed to give electronic tuning over as wide a frequency range as possible at the expense of output power. Since the resonant circuits are external to the tube, the klystrons can be used for a number of different applications. With the cavity now used in television relay links, the tube is operated in the seventh mode, 1.0-1.6 watts is obtainable, and the frequency is linear with reflector voltage over a 20 Mc range. A shift of 70 Mc is easily obtained electronically with some sacrifice in linearity.

With other resonators the wavelength has been varied from 5.3 to 9 cm in the seventh mode and the tube has been made to oscillate at 4 cm with a third harmonic resonator. At reduced voltage it will oscillate at 12 cm but extensive tests have not been made.

In an attack on a similar problem, A.F. Pearce and J.B. Mayo of E.M.I. have produced a reflex klystron, the R5081, meeting many of the same specifications, i.e., 40-50 Mc electronic tuning with good linearity to prevent harmonic generation when used in frequency modulated systems. The output is about 4 watts at 4000 Mc.

The Spacing of Television Stations

J.A. Saxton of the National Physical Laboratory read a paper on the influence of non-standard tropospheric effects in television and drew some conclusions about the spacing between television stations if interference is to be avoided. The measurements cited suggest that the field strength exceeded for 1 per cent of the time is about 10 db greater than that exceeded for 10 per cent of the time. Using this fact, he was able to show curves of the transmitter spacings necessary to comply with either of the criteria, given the transmitter power and demanding a signal 30 db above the interference. In a typical case, allowing interference 10 per cent of the time, the station separation indicated was 340 Km whereas 235 Km would suffice under "normal" propagation conditions. All of his calculations concern common-frequency stations using the same polarization. Oppositely polarized signals would result in about a 10 db improvement.

The Observation of Very High Speed Phenomena

Mr. M.S. Richards of The Mullard Radio Valve Co., Ltd. described an instrument designed to facilitate the observation and recording of objects moving at very high speeds and events taking place in extremely short times. In particular, it is intended to enable very fast repetitive motion to be observed stroboscopically, and such transient phenomena as burning high explosives to be recorded.

The equipment has been designed in conjunction with an experimental image converter tube and is intended as part of a comprehensive unit to exploit the inherent capabilities of the new tube.

Electromagnetic focusing is employed and as the current in an iron-shrouded focusing coil is increased from zero it passes through a series of values where the image is in focus, each such condition corresponding to an approximately integral number of helical revolutions performed by the electrons in the focusing field. Using this method a resolution of 20 lines per millimeter can be obtained at the image on the screen, with an electronic magnification variable between 4.0 and 0.75. The focusing system used enables an erect image to be formed at magnifications of about two and four times or at the first and second foci respectively.

There are two alternative arrangements available for controlling the photographic exposure. The first is aimed at providing the shortest possible exposure for transient events where an effective shutter opening time of one-twentieth microsecond has been reached. In the second system, for stroboscopic observation a circuit has been designed which can produce pulses having durations between one millisecond and one microsecond, at repetition frequencies between twelve cycles per second and one hundred kilocycles with a maximum duty cycle of one-third.

In some applications a time-scale is desirable. This can be provided by moving the image across the screen at a known velocity. Writing speeds on the screen varying between ten millimeters per second and ninety kilometers per second can be obtained. The slower deflections, up to five hundred meters per second, are virtually linear with time, while the faster speeds are obtained by using portions of either a continuous or damped train sinusoidal deflection.

FRIEDEL-CRAFTS TYPE COMPLEXES AND CATIONIC POLYMERIZATION

A two day discussion on cationic polymerization and related problems organized by Dr. P.H. Plesch was recently held at the University College of North Staffordshire. It was attended by about 80 people, including several American and Dutch visitors.

The first part of the discussion was devoted to Friedel-Crafts type complexes, while the second part dealt with polymerization reactions. In addition, an important contribution on carbonium ion reactions on catalyst surfaces was presented from the Shell Laboratories in Amsterdam.

Technical Report ONRL-25-52 summarizing this conference will be available from the Technical Information Office, Code 250, Office of Naval Research, Washington 25, D.C. The complete proceedings will be published later this year.

While few significant new data were presented, the conference was a useful one in emphasizing the importance of rigorously controlled experimental conditions in cationic polymerization. It appears that with the notable exception of the boron trifluoride catalyzed polymerization of isobutene no definite statements can be made on the importance of co-catalysts. Small traces of water can drastically change the kinetics in many cases while rigorous drying of unsaturated molecules may also be unsatisfactory because of the possibility of chemical changes. In addition to enthalpy changes, entropy changes in polymerization reactions will have to be measured before the kinetics can be reliably interpreted.

The Friedel-Crafts type complexes discussed included those of the aluminum halides, boron trifluoride, and stannic halides. A valuable survey of the energetics of the boron complexes was presented by Skinner (Manchester). A.G. Evans (Cardiff) has obtained evidence indicating absence of complex formation between BF_3 and $CH_3\ \phi_2CCHC\phi_2$. Isobutene probably behaves in an analogous manner.

Aluminum Halide Complexes

Eley and his collaborators (Bristol) have shown that the presence of a third component, such as a hydrogen halide, is essential for the interaction of aromatic hydrocarbons with aluminum halides. They also prepared a series of complexes of the aluminum halides with nitrogen bases (pyridine, triethyl amine, and trimethylamine) and are investigating their heats of dissociation.

Polymerization of Styrene by Stannic Chloride

Pepper (Dublin) reported so far unsuccessful efforts to decide whether co-catalysts are necessary for the polymerization of styrene by stannic chloride. Inconsistent results have been obtained after extreme drying of reagents. While in general addition of water increases the rate of polymerization, in some experiments in which both styrene and solvent (ethylene dichloride) were dried for several days over freshly ignited BaO extremely fast rates were observed.

In related studies on the oxygen coordination complexes of stannic chloride, complexes with water, ethyl alcohol, acetone, and diethylether were isolated and identified by Pepper and Devlin. Their effect on the polymerization of styrene varies greatly. It is of interest that the crystalline hydrate is the trihydrate, $SnCl_4.3H_2O$, even when stannic chloride is in considerable excess during preparation. The other complexes contain two or three oxygen atoms per $SnCl_4$ molecule.

Detailed study of the kinetics of the stannic chloride catalyzed polymerization of α-methylstyrene, and of styrene in ethyl chloride enabled Dainton (Leeds) to deduce a satisfactory reaction mechanism. This consists of initiation by proton donation from a complex of catalyst and co-catalyst (water), propagation by addition of monomer to growing cation, and termination by spontaneous proton expulsion. With heavy water as co-catalyst there is a brief delay in the reaction during which the deuterium of the water is exchanged with the hydrogen of the other molecules; after this period the rate is characteristic of water co-catalysis.

Plesch (University College, North Staffordshire) presented results on the $TiCl_4$ catalyzed polymerization of styrene in various solvents. He believes that it is not the dielectric constant of the solvent, but rather the acid properties of its complexes with the catalysts which primarily determine the rate.

Isobutene Polymerization

The stannic chloride catalyzed polymerization of isobutene in other chlorides at -78.5°C can be co-catalyzed by a number of acids. K.S. Russell (Manchester) assumed that a co-catalyst is necessary in this polymerization, and showed that the rate of the reaction roughly follows the acid dissociation constant (in water) of the co-catalyst. The following co-catalysts have been used: trichloroacetic acid, chloroacetic acid, acetic acid, nitroethane, nitromethane, water, tertiary butyl, bromide, and nitrobenzene. These cover a range from extremely fast polymerization at -146°C for trichloroacetic acid to no measurable reaction rate for nitrobenzene. In pure isobutene the effects are similar but the rates are always very much lower.

Carbonium Ion Reactions on Catalyst Surfaces

The important results presented by Dr. G.C.A. Schuit (Shell, Amsterdam) on carbonium ion reactions on catalyst surfaces were somewhat outside the main scope of this discussion. Cracking and polymerization reactions were studied on silica-alumina and on fluorine promoted alumina surfaces; their active sites were quantitatively estimated by determining the amount of potassium sufficient to poison the surface, and also from ammonia adsorption (chemisorption) experiments. The catalyst pores were large ~ 100A.

Their important conclusion is that two types of active sites are operative on these surfaces; one type is active for paraffin dehydrogenation and can become active also for cracking and for polymerization reactions (radical mechanisms). The other type shows no activity for paraffin cracking but is active for propene polymerization and for olefin cracking (carbonium ion mechanisms).

NON-STEADY VISCOUS FLOWS

One of the research programs at the Fluid Mechanics Institute of the University of Aix-Marseille under the direction of Professor J. Valensi is concerned with the dynamics of viscous flows and, in particular, with the way in which oscillatory phenomena depend on the non-dimensional parameter $V=R^2\omega_0/\nu$ where R is a characteristic linear dimension, ω_0 the frequency of the motion which would have resulted had the fluid been a perfect one, and ν the kinematic viscosity of the real fluid. This parameter V, is referred to in the following as the Valensi number of a given flow performs in many respects as the same function for oscillating flows as the Reynolds number for stationary ones.

A current group of experiments in this context is being carried out by Miss C. Clarion of the Institute and concerns the free longitudinal oscillations of a rigid sphere in a viscous medium. For this purpose the sphere is mounted on a long thin strut whose other end is attached to a spring. Strut and sphere hang down into a cylindrical vessel containing the liquid. The vessel has a diameter large enough in comparison with that of the largest sphere employed to make wall effects negligible and is deep enough so that free surface effects need not be considered. The oscillations, set up by an initial impulse, are vertically up and down in the direction of the strut and are recorded by obtaining a distance vs. time diagram from the motion of the latter.

In a first experiment the system is allowed to oscillate in air in order to determine the spring constant k. Next the vessel is filled with a viscous liquid and the damped oscillations executed by the system are now observed. The period of the latter leads at once to a determination of the virtual mass M + M' of the oscillating system, consisting of the mass M of the moving solids together with the added "induced mass" M' due to the entrained liquid. The contributions by the strut to the latter are suspected not to be entirely negligible, but it is difficult to separate them out.

Next the ratios of successive maxima are determined and are found to depend on the amplitude, varying linearly with the latter. Extrapolating along this line to zero amplitude furnishes a modulus of decay for small oscillations and determines therefore the coefficient, f, in the differential equation

$$(1) \quad (M + M')\frac{d^2x}{dt^2} + f\frac{dx}{dt} + kx = 0$$

which governs these oscillations. A theory by Lamb covers this case, and the values of M' and f which it predicts are readily expressed as function of the Valensi number formed with the radius of the sphere as characteristic length. Observations obtained with liquids of various viscosities and spheres of three different radii have been reduced in this manner and were found in satisfactory agreement with theoretical predictions, thus believed to be checked experimentally for the first time.

The amplitude dependence of the ratio of successive maxima for large oscillations indicates, however, that in the general case the equation (1) must be replaced by a non-linear one. An analysis of the phenomenon on the basis of its energy budget suggests (although the dissipation function cannot be given explicitly in terms of primary data) that a term in $(dx/dt)^2$ should be included

$$(2) \quad (M + M')d^2x/dt^2 + f(dx/dt) + f^*(dx/dt)^2 + kx = 0.$$

Using the Kryloff-Bogoliuboff method of approximation to solve (2), a relation can be established between the coefficient f^* and the slope of the graph giving amplitude vs. ratio of successive maxima which in this approximation also turns out to be a straight line. It is thus possible to compute the appropriate value of f^* for each of the observed cases and to examine its dependence on V. Since the ratio of specific gravities of sphere and liquid varied from experiment to experiment, it is necessary to make a correction in the value of f^* determined from a given experiment in order to reduce it to standard condition, otherwise the points obtained when plotting f^* against V will fail to lie on a single curve. (The same is true, of course, for the determination of f where the appropriate correction comes out of the theory.) This difficulty is reported to have only recently been overcome.

RIPPLE STUDIES AT LILLE

Under the direction of Professor A. Martinot Legarde there is being undertaken at the Institut de Mecanique des Fluides of the University of Lille a systematic investigation concerning the mechanism of ripple formation in sand due to wave action. The first phase of this study utilizes a small glass walled tank of about 3 ft. depth, 8 ft. length, and 1 ft. width in which standing waves are set up. Wavelength and amplitude of the ripples, created in a sand layer at the bottom of the tank by the action of the waves, are to be studied in their dependence on the mean size of sand grain, the depth of the sand layer, and of the water, as well as the period and amplitude of the standing water waves. In order to avoid at least some of the difficulties characteristic of the mechanics of unconsolidated materials, an artificial sand will be used of nearly spherical grains having appropriately scaled density.

The results of a first preliminary experiment, made with ordinary beach sand at the bottom of the tank in order to test the satisfactory operation of the model, showed well formed ripples which had reproducibly a wavelength equal to 1/13 of the length of the standing wave which produced them.

A second phase of this investigation is contemplated to make use of the 70 ft. long channel of 5 ft. depth at the Institute, where it will be possible to observe the ripple formation due to progressive waves running up an inclined beach.

ENDOGENOUS PRODUCTION OF AN ALLOXAN-LIKE SUBSTANCE

When the Archibald test for alloxan (J. Biol. Chem. 158, 347 (1945)) is applied to the blood following oral glucose administration, a positive reaction is obtained in rats, dogs, and men. The appearance of this substance in the body has been studied by Professor Loubatieres in the Department of Physiology, University of Montpellier, using this reaction which is based on the fluorescence spectrum produced by an alloxan derivative. The substance which he finds in blood and tissue in experimental animals has a fluorescent spectrum which is identical with that of alloxan, but the concentration of this substance in the body is very low, making it difficult to assert definitely that the substance found experimentally is identical with alloxan. The concentration of this substance is equivalent to 0.2 mg. per liter in the blood and rises to 11.0 mg. per liter during a 90 minute period following glucose administration and then returns to normal levels. Since intraperitioneal injections of glucose do not cause this rise of "alloxan" in the blood it is thought that it is produced by the intestine.

Well washed duodenal mucosa was also found to produce an alloxan-like substance in vitro in the presence of glucose but not in its absence. When the intestine of a rabbit is perfused with Tyrode's solution very little "alloxan" is found in the efferent fluid. When glucose is added to the afferent Tyrode solution, "alloxan" is found in the fluid leaving the intestinal veins. Alloxan injected intravenously in rabbits disappears very rapidly from the circulating blood. When the rate of disappearance is considered, the amount of "alloxan" found in the blood in these experiments assumes greater significance for it represents the release of physiologically important amounts. In dogs rendered diabetic by surgery or pituitary extract injections an increase in "alloxan" in the blood was found when their blood glucose rose to high levels. These experiments imply a very important role of an "alloxan-like" substance in the pathogenesis of diabetes of the clinical variety as well as in experimental diabetes produced by glucose or pituitary administration. They also suggest that the alloxan diabetes discovered by Shaw and Dunn may be quite closely related to these other forms.

Professor Laboutieres wishes to emphasize that the experiments are preliminary and the identification of the "alloxan-like" substance with alloxan rests on the specificity of the Archibald technique.

THE PRODUCTION BY ALGAE OF MATERIAL TOXIC TO FISH

Due to the extreme shortage of protein production in Israel, there is a major interest in fish culture. A large number of shallow ponds have been constructed in which fish can be reared. Several species have been used but by far the greatest proportion is the European carp. This fish is adapted to the brackish water, too salty for irrigation purposes, with which most of these ponds are supplied.

The fish are fed a basic diet which consists mainly of cottonseed oilcake, though some food is obtained from the pond itself in the form of microscopic plant and animal life. This latter proportion of their diet, although minor in quantity, apparently contains some elements which are very important in their dietary requirements. Under average conditions approximately one ton of carp can be obtained per acre of pond per year.

An important problem has arisen in connection with fish culture due to the growth of an alga, Prymnesium parvum, a chrysomonad, which under some conditions produces a substance which is very toxic to all gill-breathing animals. This material is apparently a neuro-toxin and various species differ in their sensitivity to it. Unfortunately, the carp is one of those which is easily destroyed by the poison.

Dr. M. Szelubski of the Department of Chemical Microbiology, Hebrew University, Jerusalem, is taking an active interest in the investigation of the properties of this toxin, the factors affecting its production, and methods of control of the alga.

The alga grows rapidly during periods of relatively low temperature. However, there is a poor correlation between the number of algae in a pond and the amount of toxin produced. Apparently some factors, such as light or available nutrients in the water, affect the rate of toxin production. The toxic material is rather easily oxidized and is adsorbed readily on sand. One method of control has been to stir the bottom sand of the pond so that the toxin readily comes in contact with the particles. The alga which produces this material can be killed by the addition of ammonium sulfate to the water, a method which has proven useful in practice. In addition, the excess ammonium sulfate stimulates the growth of desirable organisms which add to the natural food available in the pond. Laboratory studies indicate that pyridine mercuric acetate will prevent the growth of the alga when added to the water in very minute amounts. Studies are under way on the biological control of the algal growth by introducing other algae which inhibit the production of the unwanted type. Some bacteria may also have a similar favorable action.

TECHNICAL REPORTS OF ONRL

The following reports have been forwarded to ONR, Washington, since the last issue of ESN. Copies may be obtained from the Technical Information Office, Code 250, Office of Naval Research, Washington 25, D.C.

ONRL-24-52	"Radioastronomy at Jodrell Bank University of Manchester" by S.F. Singer
ONRL-29-52	"Molybdenum and Molybdenum Alloys" by E. Epremian
ONRL-42-52	"Institute of Opthalmology, London" by G.K. Smelser

PERSONAL NEWS ITEMS

Dr. Hans Frauenfelder, nuclear physicist at the Swiss Federal Institute of Technology (ETH) in Zurich, is leaving the ETH to join the staff at the University of Illinois.

Professor Henry Terrey has been appointed to the University Chair of Chemistry at University College, London.

FORTHCOMING EVENTS

The General Assembly of the International Astronomical Union (I.A.U.) will be held in Rome, September 4 - 13, 1952. Symposia will be held in connection with the meeting on the Astronomy of Faint Stars, Stellar Evolution, and Instrumentation. The Executive Committee of the I.A.U. which met last August has appointed Professor Oosterhoff of Leiden as assistant to the General Secretary, Professor Strömgren; all correspondence concerned with the forthcoming General Assembly should be addressed to Professor Oosterhoff.

Prepared by the Scientific Staff
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