such regulation are manifold but primarily because many of these norms and values are in conflict." The problem of conflict of commitment in the assessment of personality and its implications for the regulative process were extensively developed. He argued that psychologists should not refuse to implement self-regulation, but he also urged that they should be cautious and insist that any change in standards be based upon their intrinsic merits and not upon external pressure. He agreed that a few unethical practices may have occurred along with certain inadequacies of technique, but, he said, "The majority of recent criticism seems to have been incurred more through the misconceptions and restricted purview of our critics than through the incompetence and ethical lapses of our colleagues." As an example of the dilemma faced by psychologists, he considered various uses of assessment; for example, in diagnosis and guidance, in selection of personnel for industry, and in research. Regarding the problem of industrial assessment, he said, "The institutional psychologist is especially open to conflicts in his commitment to the individual applicant and to his institution, particularly in his attempts to implement institutional policies through an assessment program. He has an obligation to the institution to see that its selection decisions are based upon optimally valid and economical assessment procedures. But he also has an obligation to protect the dignity of the individual applicant by ensuring that the assessment experience is not unduly offensive. By what norms, however, do we judge the infringement of one obligation upon the other?"

Even in research the psychologist finds himself faced with a difficult choice. He desires to further knowledge regarding psychological problems. This often requires him to use somewhat disguised techniques so that the subject will not be made aware of the particular area being studied. According to the ethical standards of the APA, "Only when a problem is significant and can be investigated in no other way is the psychologist justified in exposing research subjects to emotional stress." Messick asked by what criteria we judge when the potential significance of a research problem offsets the possible threat to the subject's welfare. Messick attempted to resolve these difficulties by saying, "Thus, in our consideration of possible ethical bases for self-regulation in assessment, it seems imperative that we go beyond ethical absolutism and espouse an 'ethics of responsibility' in which pragmatic evaluations of the consequences of alternative actions form the basis for particular ethical decisions." Summing up his position, Messick said, "If the pressures of reality lead us to establish further policy-based self-regulation in psychological assessment, it would seem imperative to include at the same time formal provisions for its continuing reappraisal. The intention here is not to subvert the utility of policy as a regulative principle, but to moderate its impact on the atmosphere of the regulated domain and, above all, to keep the dialogue open."

The final presentation was made by Ralph Berdie, chairman of the American Psychological Association's *ad hoc* committee on social impact of psychological assessment, who described the committee's work. Berdie said, "Broadly, the Committee is concerned with assessment in terms of what psychologists should do, what they do, and how they are seen." He said the functions of the committee include keeping APA informed of the opinions of various audiences regarding psychological assessment, advising APA regarding actions necessary to increase the desired and decrease the undesired impact of assessment, and advising APA concerning the consequences of assessment on society and also on professional and scientific psychology.

Berdie cited a large number of illustrations from the committee's files regarding both negative and positive actions toward assessment practices. He mentioned several instances where test booklets and questionnaires have been burned by various educational agencies. He also cited a number of instances where important policy decisions about tests have been made by education departments or other public institutions without consulting experts in the field. Among positive instances he cited cases in which state psychological associations and guidance groups have become active in educating legislators regarding these problems. The recent deletion of a proposed amendment to the National Defense Education Act which would have prohibited certain types of testing was cited as another example. Recently Harvard University has published a statement of rules governing the use of humans as subjects of research. These and other examples were cited as the raw material upon which the committee would base its recommendations.

A lively discussion followed the presentation of the formal papers. A number of speakers from the floor emphasized the seriousness of the problems discussed and felt that professional people interested in assessment should take a very active role both in helping to formulate technical solutions and in educating the public regarding good assessment techniques. There were also comments from the audience regarding the questionable quality and professional standard of much of the current criticism of psychological testing. There seemed to be agreement that the American Psychological Association and other concerned professional associations should take active and vigorous steps to establish and enforce appropriate standards. At the same time, we should mount an educational program directed to other professions, legislators, governmental agencies, and the public emphasizing the very important role assessment techniques play in our present civilization and outlining proper standards of practice.

LAUNOR F. CARTER
*System Development Corporation, Santa Monica, California*

## Rapid Mixing and Sampling Techniques

An evaluation of currently available techniques and an exploration of the possibilities of future developments in the study of rapid reactions in biological systems were made at a colloquium held at the Johnson Research Foundation, University of Pennsylvania, Philadelphia, 23–24 July 1964.

Rapid mixing and fluid flow in continuous and stopped flow apparatuses were considered first, together with supplementary methods (flash photolysis and temperature jump) for perturbing the chemical systems. F. J. W. Roughton described the development in methods and showed that the method used in 1923 is the forerunner of most of the methods under study today. A discussion on the current problems of today's apparatuses, namely the rapid flow and mixing of fluids, followed. R. L. Berger presented a detailed evaluation of four to ten jet mixers; the latter shows 98 percent mix-

ing in a distance of 5 mm. Berger, after demonstrating that rapid mixing was essentially unaltered in mixing 300 centipoise glycerol with water, showed the small influence of viscosity on mixing efficiency. G. Czerlinski described a concentric mixer with a curved continuous channel mixer instead of jets. His figures indicated at least 88 percent completion of mixing at 1 cm from the mixing point. Mixing processes were illustrated by flash photographs of jet collision phenomena (M. Sangster) and mixing of indicators in the observation tube of a rapid flow apparatus (R. L. Berger) were shown in a slow motion film.

The general problem of limitations set on fluid flow in observation tubes by cavitation was discussed by B. Chance, who described a pneumatically-driven, pulsed flow apparatus for optical observations of intact cell suspensions. This technique employed 2 to 10 atmospheres of back pressure to eliminate an otherwise serious cavitation effect. It seems that Czerlinski's apparatus also inadvertently relied upon back pressure to diminish cavitation.

Chance further described the application of photomultiplier-detected microscope observations in a 1-mm capillary so close to the mixing point that the cavitation bubbles were small enough not to interfere with optical observations. Similar findings were reported by Berger. This region was denoted as the "precavitation" zone but might better be termed the "pre-bubble formation" region.

Four types of mixers suitable for operating in an open cuvette were described—a moving ball mixer (R. L. Berger) in which the ball initially separated the reactants and mixing was dependent upon the high degree of turbulence caused by rapid movement of the ball (15 msec mixing time); a movable mixing chamber (M. Klingenberg) in which a jet assembly was rapidly passed through a cuvette (16 msec mixing time); a related design (P. Strittmatter) requiring only a small volume (30 $\mu$l) and attaining a mixing efficiency of 98 percent within 3 msec; and an apparatus for multiple mixing of reactants in a small volume in a time of 25 msec, with the interesting feature of projection of the driving rod by a blank cartridge (D. M. Lübbers). In all these systems, cavitation appears to limit the earliest reading time.

Current designs of stopped flow apparatus were described by J. Sturtevant, R. L. Berger, and Q. H. Gibson; special attention was paid to adequate criteria for their evaluation. In all cases, the use of computers for evaluating the kinetic information is actively under consideration. While Sturtevant's and Gibson's apparatuses were primarily for optical determinations, Berger's was designed primarily for thermal measurements or for both optical and thermal determinations of high accuracy. A novel feature of Berger's apparatus was the inclusion of a pneumatically-driven stopping valve which operates in fractions of a millisecond. This was found under some conditions to result in destructive shock waves when used to stop high velocity flow streams (20 m/sec), thus limiting the experimental usefulness of the technique.

Discussion of the basic problems in flow apparatuses underlined a number of essential points and design trends. The fluid economy of the "cuvette" type mixers was recognized to be very high. It was felt, however, that stringent and detailed mixing tests must be applied to them whenever small volumes of reactants are mixed with larger volumes. In addition, viscosity differences often introduce mixing and flow artifacts which are difficult to evaluate. Some divergence in the basic philosophy of mixing appeared. One group recommended a large kinetic energy loss in the mixer and many jets—a viewpoint certainly supported by the trend of empirical design by Gibson, Chance, and Berger. On the other hand, the "jetless" type of mixer, proposed by Czerlinski, presents advantages from the standpoint of maximum flow velocity and its ability to bring reactants into close physical proximity. Whether these advantages can counteract its probable deficiency of mixing remains an interesting question for further study.

The question of driving functions for flow apparatuses, either stopped or continuous, was considered now that higher driving forces and more rapid stopping devices are possible. It is apparent that a driving function can be employed which gives a gradual stop in order to minimize mechanical damage. Just how far the 1- to 2-msec stopping time of most stopped apparatuses can be reduced is not clear at the present time because of the possibility of structural damage caused by shock wave generation.

Special designs of continuous flow apparatus for studies of cell suspensions were described by B. Chance. High pressure pneumatic drive delivers approximately 1 liter per second through a 1-cm$^2$ area observation tube and achieves a time resolution of 1.7 msec in this apparatus. Avoidance of cavitation and stopping the driving piston without damaging the apparatus are achieved by back pressure.

Two types of flow apparatus for EPR studies were described; both types used continuous flow. They were the conventional type of mixer (L. Piette) and a mixing chamber built as closely as possible to the top of the active portion of the microwave cavity (D. Borg). Special reference was made to the problem of determining the speed and degree of mixing in this portion of the cavity. The use of averaging computers in conjunction with such apparatuses was also discussed, particularly for retrieving data of phenomena of unknown rapidity. But when the approximate rapidity of the phenomenon is known, the utility of such data averaging methods in conjunction with the rapid flow technique can be questioned. The interval over which information is averaged is made equal to the duration of the flow in the observation tube and can be increased to give the desired accuracy figure.

Perturbation of the flow stream by photolysis using xenon flash tubes (C. Greenwood) and the Q-switched laser (D. DeVault) was discussed. The topic included the use of existing flash tubes and the possibilities of obtaining measurements soon after the 30-nsec laser flashes. Practical application of the techniques, such as the photodissociation of the CO complex of cytochrome $a_3$, was described by DeVault.

Potential application of temperature jump technique to continuous flow apparatuses was described by Eigen and DeMaeyer and by Czerlinski. The former workers are developing a technique employing the application of $10^5$ volts across a 1-cm length of observation tube, which produces a change of several degrees in 1 $\mu$sec. Czerlinski described the potential use of temperature jump heating at 1.34 $\mu$ with an Nd crystal laser and measurement of the reaction at 633 m$\mu$ with a continuous helium-neon laser. Design calculations suggest that 10 joules in the 30-nsec laser flash would give a 5 degree rise in a .2-cm$^3$ observation tube. Microwave heating, as described by Ertl and Gerischer, was also discussed; apparatuses under develop-

ment, particularly those using laser heating, appeared to have special advantages for the study of a wide range of chemical reactions.

The discussions of the second day (organized by R. H. Eisenhardt and K. K. Lonberg-Holm) were divided into three major areas: liquid-liquid quenching, tissue-freeze quenching, and rapid sampling. Under the topic of liquid-liquid quenching was included the subject of the rapid freezing of liquid jets upon being squirted into a cold immiscible liquid (R. C. Bray, G. Palmer, and H. Beinert) and upon being aimed directly into a second jet of cold liquid (M. Sangster). A number of the problems inherent in these methods were discussed; some items noted were the estimation of quenching time and the possible difficulty in stopping intermolecular reactions or reactions with protons or gaseous species which might occur in the frozen state. Bray, Palmer, and Beinert have already employed cold quenching in EPR and in reflectance spectroscopy studies of enzyme kinetics. The quenching time available with current mixers and freezing techniques is approximately 10 msec. It was concluded that under most circumstances intermolecular reactions can be satisfactorily quenched at −180°C. The desirability of carrying out parallel studies by direct physical measurement and by quenching was pointed out.

Some of the artifacts which may be caused by a variety of chemical quenching methods were touched upon with particular reference to liver tissue (T. H. Bücher), yeast cells (T. Savioja), and *Chlorella* (J. A. Bassham). In the case of *Chlorella* and also in mouse ascites tumor cells alcohol quenching was found to be very convenient, but it could not be demonstrated that the quenching time was less than 200 msec. Much shorter quenching times can be demonstrated in whole yeast cells when TCA is employed (J. K. Miettinen). Acid or alkali are eminently suited for use as quenching agents when simple enzyme solutions are used (H. Gutfreund) and seem to require less than 1 msec if the reaction is not heavily buffered.

The rapid freezing of muscles in varying states of contraction was discussed by D. F. Cain and by W. F. H. M. Mommaerts. Cain, using Freon 13 to −180°C, reports that a 1-sec time interval is required to reach −55°C with 2 $mm^3$ of tissue. Mommaerts gives the same time interval for cooling a 150-mg sartorius muscle. It is suggested, however, that 80 to 90 percent of the mass passes through ice crystal formation within 50 msec or less.

Metabolite assays on quickly frozen samples of liver were described by Bücher. This technique involves not only the quick freezing method but also the complete analysis of small slices of frozen tissues carried out at −25°C. The results suggest that these methods are necessary to maintain the metabolite pattern in general and the nucleotide concentration values in particular.

A number of methods for withdrawing samples from transient or steady state metabolic systems were presented. Lonberg-Holm described a rotating stopcock type sampler and a newer "aspirator" type sampler which has been used to take aliquots from ascites tumor suspensions at 0.7-second intervals after glucose feeding. Eisenhardt described a constant, aliquot "single drop" type sampler which was built to study transients in mitochondrial metabolism and which permits sampling at 0.3-second intervals, 0.5 or 0.8 second after a substrate is added to the reaction. This latter sampler could be adapted to a completely automatic mode of operation which would permit an experiment to be programmed ahead of time. Miettinen described three types of apparatus developed for the study of phosphorus assimilation in yeast—a magnetic valve type sampler, a multiple mixer flow apparatus, and a syringe type injector for quenching samples shortly after substrate addition. A more complex sampler employing syringes was also described by V. Moses. This latter device, together with the magnetic valve equipped reaction chambers described by Bassham and by M. Klingenberg, may be more suited to the investigation of the steady state or of slow metabolic changes than of rapid transient changes. Klingenberg also reported a novel, rapid filtration technique involving zonal centrifugation.

To study really rapid reactions by chemical means (by taking samples at less than 200 msec intervals), it appears at present to be necessary to employ a "quenching type" or multiple mixer type flow apparatus. The disadvantage in such a method is that only one sample may be obtained from each run and biological material may not remain in the same state for a period of time long enough for an experiment. Gutfreund has used a quenching type flow apparatus to study the kinetics of several enzyme systems and has been able to get good agreement with results obtained from the stopped flow technique.

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BRITTON CHANCE
QUENTIN H. GIBSON
*Johnson Research Foundation, University of Pennsylvania, Philadelphia*
RUDOLF H. EISENHARDT
*Harrison Department of Surgical Research, University of Pennsylvania*
K. KARL LONBERG-HOLM
*Central Research Department, E. I. du Pont de Nemours and Co., Wilmington, Delaware*

## Forthcoming Events

### January

*3–10.* **High Energy Physics**, 3rd annual symp., Inst. of Mathematical Sciences, Madras, India. (R. Vasudevan, Inst. of Mathematical Sciences, Madras 20)

*5–7.* **Glass Formation, Phase Equilibria, Nucleation and Crystal Growth**, symp., Sheffield, England. (D. Hawksworth, Soc. of Glass Technology, Thorton, 20 Hallam Gate Rd., Sheffield 10)

*5–8.* **Solid State Physics**, 2nd annual conf., H. H. Wills Physics Laboratory, University of Bristol, England. (Administrative Assistant, Inst. of Physics and Physical Soc., 47, Belgrave Sq., London S.W.1)

*6–8.* **Industrial Electronics and Control Instrumentation**, 13th annual conf., Philadelphia, Pa. (E. Weiss, Sun Oil Co., Marcus Hook, Pa.)

*6–9.* **Psychopharmacological** Conf., Czechoslovak Medical Soc., Psychiatry Section, Jesenik Spa. (M. Vojtechovsky, Budejovicka 800, Pavilion A1, Prague, Czechoslovakia)

*8–9.* **Orthopaedic** Research Society, New York, N.Y. (R. A. Calandruccio, 869 Madison Ave., Memphis, Tenn.)

*9–14.* American Acad. of **Orthopedic Surgeons**, annual, New York, N.Y. (H. K. Hart, AAOS, 29 E. Madison, Chicago 2, Ill.)

*10–16.* The **New Science**, symp., Colorado Springs, Colo. (F. A. Sondermann, Colorado College, Colorado Springs)

*11–14.* **Civilian and Military Uses of Aerospace**, conf., New York, N.Y. (I. B. Laskowitz, New York Acad. of Sciences, 2 E. 63 St., New York)

*12–14.* **Reliability and Quality Control,**