tion with the stepwise procedure through the addition of a gradient producing device, the Phoenix Varigrad. Provisions exist for the installation of five chromatographic columns, the length and diameter of which are optional. A Teflon rotary manifold facilitates selection of effluent from the appropriate column and its direction either to the monitoring portion of the instrument or its diversion to auxiliary equipment prior to monitoring. Recording spectrophotometry provides identification and quantitation of sample constituents. A three-channel recorder plots absorbances of the column effluent at two selected wavelengths, in the ultraviolet range, while the third channel simultaneously records the ratio of the two absorbances.—R.L.B. (Phoenix Precision Instrument Co., Inc., 3803 N. 5th St., Philadelphia 40, Pa.)

Circle 5 on Readers’ Service card

Glass manometer originally designed for use by students in introductory organic chemistry is suitable for measuring pressures in the 0- to 140-mm range in any laboratory. The manometer and scale are encased in a heavily-walled test tube, fitted with a two-holed rubber stopper. One end of the U-tube protrudes through one of the openings; the other one contains a small T-shaped length of glass tubing by which the manometer is attached to the evacuated system. This novel construction reduces the possibility of breakage when the system is assembled and disassembled. It also prevents the loss of mercury. Should any mercury escape through the small filling hole, it will be caught in the bottom of the test tube. Approximately 1 oz of mercury is required. A mechanical pump is recommended for evacuating the system. If desired, an infrared lamp may be used for heating. All glassware is hard borosilicate.—R.L.B. (Scientific Glass Apparatus Co., Inc., Bloomfield, N.J.)

Circle 6 on Readers’ Service card

Combustible and toxic gas alarms detect minute leakage of either toxic or explosive gases and vapors wherever the processing, storing, shipping, or use of combustible or toxic liquids or gases are involved. The TOX-EX alarm system features a meter that combines both the explosive scale and the toxic scale calibrated in parts per million. These detection instruments automatically give both audible and
visual warning before hazardous conditions reach the danger point. They also provide automatic control for hazardous processes such as solvent evaporation. An eight-station instrument permits multiple sampling of the atmosphere in various rooms, or at eight stations in sequence, with sampling time of 30 sec per station. Where constant sampling or monitoring is necessary, another model is recommended. The manufacturer guarantees the instruments for 10,000 hours, or more than 1 year between servicing. Pulsed alarm and pilot indicators give the failure mode if malfunction of components should ever occur. Solid-state circuitry and specially designed analysis cells assure accuracy, stability, and long life. Stable and accurate toxic (combustible gases or vapors) or explosive indication is given by audible and visual alarm which is adjustable, pulsed, and local, or remote. The eight-station instrument has explosion-proof construction for wall or rack mounting in hazardous areas, requires a power input of 115 volts, 60 cy, 400 watts, and measures 42 inches high by 30 inches wide by 8 inches deep.—D.J.P. (Erdco Engineering Corp., 136 Official Rd., Addison, Ill.)

Circle 7 on Readers' Service card

Short-path-length ultraviolet microcell permits the analysis of small quantities of highly absorbing samples in the ultraviolet and visible regions of the spectrum. Use of this unique cell obviates the waste of time and sample incurred by repeated dilutions necessary with ordinary cells. By simply changing spacers, the path length of the new cell can be varied between 0 and 2 mm. Either Teflon or lead spacers can be supplied to cover the complete range 0.007 to 2 mm. Cells, however, can be ordered with shorter path lengths down to a fraction of 1 μ. The cell consists of two stainless-steel plates between which two high-quality fused silica windows, separated by a spacer, are sandwiched. Two holes drilled in one of the windows are in juxtaposition with two holes in one of the stainless-steel plates, serving as inlet and outlet. The inlet is connected to a capillary and the outlet to a Luer syringe holder. Both can be closed by means of Teflon plugs. The cell is self-filling by automatic siphoning when the end of the capillary is dipped into the sample. There are two types of the new microcell available. The UV-0-1 is completely in 18/8 stainless steel. The
Volume of the cell is small and is in the range of 0.018 to 0.230 ml for the 0.007- to 2-mm path length range. The fused silica windows used in UV-0 cells are transmissive to below 180 mµ—R.L.B. (Limit Research Corp., P.O. Box 852, Darien, Conn.)

Circle 8 on Readers' Service card

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Picoammeter (model 417) is said to provide at least a tenfold increase in speed of response over other available instruments. Ranges extend from $10^{-15}$ amp full scale to $3 \times 10^{-9}$ amp. Zero drift is less than 1 percent in 24 hr and calibrated current suppression is provided to 1000 times full scale. Circuitry is all solid state except for the electrometer tube. Accuracy is said to be within 3 percent. A 3-volt, 1-mm output for recorders is available for full-scale signals on any range. Plug-in design of the instrument permits location of the amplifier up to 30 m from the instrument chassis. Accessories are available to facilitate remote operation. When fast response is unnecessary, adjustment of rise time may be made with a front-panel damping control. The current suppression feature of the instrument permits full-scale display of 0.1-percent variation in signals as small as $10^{-9}$ amp. Four in-line dials provide direct readout of the suppression current. The instrument derives its high speed of response from a high-gain d-c amplifier and a critically damped feedback network. Dimensions are standard for rack mounting but a conversion kit is available for bench mounting.—J.S. (Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio)

Circle 10 on Readers' Service card

Viscometer which analyzes fluid substances by placing a small sample between a rotating metal cone and a stationary flat plate is now available with four distinct improvements. Viscosity value readings depend on maintenance of a constant rate of shear speed, variable from 2 to 20,000 reciprocal seconds and accurate to 0.2 percent. Rotation speed is precisely controlled, from 10 to 1,000 rev/min. The four improvements claimed are: maximum operating sample temperature has been increased from 30° to 200°C; truncated cones have been provided, to permit the analysis of materials with larger particles in suspension and greatly increase the range of materials the instrument can handle; provision for automatic programming and recording facilities, thus adding to the efficiency and speed of the machine's operation; a precision gap setting arrangement between cone and plate has been introduced with a heating element surrounding the supporting column. Another feature of the viscometer is that it can record viscosity values by using extremely small samples (less than 0.5 ml
in volume). A notable claim of the machine's advantages over conventional types of viscometers is that it is rapid in operation and can measure many samples in a given time, either in the laboratory or in production and processing of fluids and related substances. It is also said to be extremely quick and easy to clean before refilling.—R.L.B. (Ferranti Electric, Inc., Industrial Park No. 1, Plainview, N.Y.)

Circle 11 on Readers' Service card

X-ray tube is designed for operation with the Jarrell-Ash Microfocus X-Ray Generator in applications such as: determination of crystal structures, textures, orientations, and deformations; investigations of low-angle scattering; identification of substances through diffraction pattern comparison; and macroradiography of biological specimens and thin metal sections. The new tube features complete interchangeability of a wide selection of low-cost targets and cathode guns. The interchangeability feature permits the use of spot shapes, sizes, and orientations to assure unlimited application versatility from the single x-ray tube. The tube is said to deliver from 9 to 13 times the intensity of conventional vacuum-sealed tubes, because of greatly increased electron bombardment at the target by means of a unique electrostatic lens system which serves to focus the electrons into a localized target area (1.4 mm by 100 μ, or optionally, to a 40-μ spot). The inexpensive targets last from 600 to 1000 hr and can be replaced, in minutes, to prolong indefinitely the life of the tube itself.—R.L.B. (JarrellAsh Co., 26 Farwell St., Newtonville, Mass.)

Circle 12 on Readers' Service card

Low-cost infrared spectrophotometer (model 337) is a grating instrument which covers the broad range of 4000 to 400 cm⁻¹, 2.5 to 25 μ; the range includes longer infrared wavelengths, extending to the carbon-bromine vibrations and out-of-plane aromatic carbon-hydrogen bonds, and also provides useful data on inorganics and metal-oxygen or metal-nitrogen bonds in complexes. Usable with standard accessory equipment, the instrument features an efficient filter-grating monochromator and is available with either linear wavelength or linear wave number presentation. Its total range is divided between two standard 8½ by 11 charts for flexibility of recording, and to give absissa scales adequate to show

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Circle 13 on Readers’ Service Card

Photo-plethysmograph and control unit provides a convenient method of adapting standard electrocardiograph machines, oscillographic recorders, and oscilloscopes to recording or viewing of peripheral pulse wave forms and relative vascular volume changes. It provides a d-c output for studies where relative position is change in position of the base line is of importance, or a low-frequency a-c output should only pulse wave-form measurements be desired. This unit finds its greatest areas of application in the field of psycho-pharmacological studies to indicate subject response to stimuli, effective drugs, or other conditions. In this use, the equipment is frequently used on the d-c basis, and may be used to compare two areas, for example, temporal artery and finger. It is particularly valuable in use during surgical procedures when it can be used to monitor pulse as a reflection of cardiac output, vascular changes indicating shock, where there is a constriction, or other vascular changes as a result of drugs or surgical procedures. In all instances, it can be readily used as a sensor for heart rate. It is also valuable in determining relative blood flow, and with an occlusive cuff it can be used to determine systolic pressure. The unit will be of interest to surgeons, anesthetists, physiologists, pharmacologists, neurophysiologists, and so forth, as a means of expanding the capability of instruments already in their possession. The model PCB-AD photo-plethysmograph and control unit is a complete system, consisting of the model PCB-1 photo-plethysmograph pulse transducer, the model PCB-2 control unit, and the model PCB-3 interconnecting cable. The photo-plethysmograph transducer is a photoelectric device. It consists of a grain of wheat light source and a photocell, both contained in a small plastic housing designed to operate from any location on the subject where an artery lies near the surface. A beam of light is directed into the vascular bed and is reflected and picked up by the photocell. As the blood volume changes in the area being observed, the intensity of the reflected light is also changed and is observed by the photocell. This device is sensitive only to relative changes of light intensity. It changes not sensitive to pressure changes on the transducer or to motion to the transducer. The control unit converts this observed volume change to a proportional electrical pulse wave form for use directly into EKG and oscillographic recorders or oscilloscopes. The control unit is equipped with a ten-turn calibrated dial which is employed to

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**Circle 14 on Readers' Service card**

Portable **direct-reading oxygen gage** is designed for monitoring the oxygen content of inert gases and for measuring the flow of oxygen into a vacuum. For monitoring, the instrument has a range of from 1 to 200,000 parts per million. For measuring oxygen flow into a vacuum, calibration is in partial pressure of oxygen on a scale from $10^{-4}$ to $10^{-2}$ mm-Hg. Accuracy of the gage is said to be $\pm 3$ percent and response time is $10^{-1}$ sec. Power requirement is 25 watts at 120 volts a-c. Response of the instrument is logarithmic. It is not sensitive to the presence of water and carbon dioxide and these constituents of a gas stream do not alter the instrument's sensitivity to oxygen. The test cell of the sensing element consists of solid electrolyte that does not diffuse volatile contaminants into the monitored gas stream or into the vacuum system. The instrument measures 20.3 by 22.9 by 30.5 cm and weighs 6.8 kg.—J.S. (Westinghouse Electric Co., Box 2278, Pittsburgh 30, Pa.)

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**Vibrating capacitors** are available in four series for vacuum-tube drive, transistor oscillator drive, synchronous drive 6.3-volts a-c; and frequency doubling 6.3-volts a-c drive. The first two can be furnished for any specified frequency from 300 to 700 cy/sec, the third for any specified frequency from 60 to 500 cy/sec, and the fourth for any specified frequency from 60 to 250 cy/sec, the output frequency being twice the drive frequency. Specifications for high-performance models include: capacitance, 10 pf static each channel; input voltage, 100 volts maximum; minimum insulation resistance, $10^{10}$ ohms; maximum contact potential, including drift, 20 mv; maximum contact potential drift at constant temperature $\pm 0.1$ mv/24 hr, noncumulative; temperature coefficient of drift 0.03 mv/°C; conversion

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Circle 16 on Readers' Service card

Vacuum heating stage for microscopic examination of metals and other materials permits heating of specimens to 1750°C with thermometer measurement of temperature. The stage is designed for observation by incident light. The vacuum chamber is mounted on a spherical bearing to permit the surface of the sample on the heating stage to be aligned parallel to the surface of the microscope stage. The sample to be observed is placed over the thermocouple like a thimble. As a rule, the sample is heated indirectly by means of low-voltage heating elements of tantalum. Screened plates, also of tantalum, enclose the heating cylinder and concentrate the heat onto the sample. The heating elements and the interior of the chamber are covered by a radiation protection plate. Only the surface of the sample remains visible through a small observation window. A quartz disk arranged eccentrically over the sample and rotatable through 360° closes the chamber so that it is vacuum sealed. If the window space above the sample becomes clouded, it can be renewed up to 25 times by turning the cover to a clear area. The heating stage objectives are corrected for the thickness of the quartz glass window. For examinations at 1750°C the stage is equipped with a platinum-rhodium thermocouple. For observations at temperatures above 1750°C, a micropyrometer can be used for measurement of temperature.—J.s. (E. Leitz, Inc., Scientific Instrument Div., 468 Park Ave., New York)

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Micro-flow pump plugs into any 117-volt a-c source and operates by electrolysis. The pump assembly consists of a glass pumping chamber and a piston within which gas is generated to drive fluid at reproducible, uniform rates. The pump offers continuously adjustable flow rates ranging from 1 ml/14 hr to 1 ml/24 hr. A second model offers eight specific rates within PENNNTUBE III
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—R.L.B. (National Instrument Co., 4119 Fordleigh Road, Baltimore 15, Md.)

Operational amplifier (model 3821) is a transistorized amplifier said to match performance of vacuum-tube amplifiers in voltage range, power, and gain. Output is ±100 volts at 20 mA and ±60 volts at 40 mA. Open-loop gain at d-c is typically 5 x 10⁶ and minimum gain is 2 x 10⁵. Drift, referred to input, is 50 μV in 8 hr at constant temperature; 175 μV/10°C from -20° to +45°C; 200 μV/10°C from -55° to +55°C. Input current is 10⁻¹⁰ amp and integrator drift is 150 μV/sec. Noise is 2 μV r.m.s. and typically 25 μV pk-to-peak. Response is down 3 db at 50 kcy/sec. Input impedance is 500 kohms at d-c and 100 kohms at 300 cy/sec. Output imped-
The amplifier is capable of driving galvanometers, process control elements, and servo control equipment directly without auxiliary circuitry. It is compatible with standard electronic instruments and is interchangeable with vacuum-tube amplifiers.—J.s. (Systron-Donner Corp., 888 Galindo St., Concord, Calif.)

Circle 20 on Readers' Service card

Magnetic tape–paper tape converter (model D427) accepts input records of various sizes and codes them for direct processing by a computer. The device converts magnetic tape to paper tape at a speed of 300 characters per second and converts paper tape to magnetic tape at 1000 characters per second. It accepts 5, 6, 7, or 8 level paper tape, produces tapes compatible with the I.B.M. 1401 or 7090 computers, and produces 5, 6, 7, or 8 level punched paper tape. The converter is equipped with a plugboard that allows 6-bit code translation as well as various fills, inserts, character flagging, and other features necessary to accommodate input records of various sizes. The memory provides 1024 characters of storage. Read-after-write checking is included in the magnetic tape output operation.—J.s. (Digitronics Corp., Albertson, N.Y.)

Circle 21 on Readers' Service card

Infrared laboratory test panel is said to heat evenly across its entire face free of hot-spot effects and to provide data that is readily transferable to process conditions. Test panels can be supplied in three face temperatures: 1200°, 1000°, and 800°F. The panels use a ceramic face as the source of infrared radiation. Formed resistance wire, embedded in an insulation block behind it, brings the ceramic face to emission temperature. Batt and reflective insulation keep the metal shell at safe temperatures. A support grill under the panel is height adjustable. Size of the panel is 0.3 by 0.6 by 0.15 m. Power is 3000 watts. A junction box is provided on the back of the panel.—J.s. (Infrared Systems Inc., Route 23, Riverdale, N.J.)

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Circle 23 on Readers’ Service card

Heat dissipating tube shield is said to put no strain on the tube contact pins; require no torque or twisting to lock into place; put no insertion force on the tube bulb; and have no tendency to pull the tube from its socket when it is removed. The tube shield is hinged at the base and opens for insertion and removal. When in place over the tube, the shield is closed and secured by a metal snap ring at the top. The interior of the shield is fitted with a flexible beryllium-copper material that grips the tube and provides heat conduction to the tube shield case. The heat is then dissipated to the component chassis. The shield is said to meet and exceed military specifications that require bulb temperature reduction of 50 percent or greater.—J.S. (Atlee Corp., 2 Lowell St., Winchester, Mass.)

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obtaining them, and the appropriate amount of money needed to support each application that is recommended for approval.

It is unfortunate that some members of the Congress and of the offices mentioned think that scientific research can operate productively when subjected to rigid fiscal controls, as can a variety of industrial or other operations supported by federal funds. It is only too easy for critics to characterize scientists working in areas of fundamental research, particularly in biological and medical fields, for whom "fiscal controls" are necessary—for their own good. Yet experienced investigators know full well that important discoveries simply cannot be made in an atmosphere of restrictive rules, regulations, and bureaucracy.

What has gone wrong? Perhaps it is to a considerable degree a result of unprecedented rapid growth in (i) the number of scientists being trained or supported by federal funds; (ii) the number and size of the grants; and (iii) the almost inevitable differences in opinion as to what constitutes essential freedom to do good research, as compared to what some apparently regard as unfettered license. In any case, although attainment of the desired degree of "fiscal control" can be insured by the development of severely restrictive regulations, the inevitable price to be paid is a reduced overall productivity of science in America. Consequently, the Congress ought to have the collective courage to question the wisdom of those "directives" of its committees and of other groups that have led to the establishment of restrictive regulations by unwilling but apprehensive agencies.

What are some of these newly made regulations that are regarded so unfavorably by scientists?

1) The requirement that grantee-investigators not be allowed to alter their objectives in a major way, except after permission has been recommended by a committee or granted by officials within the agency from which the funds were obtained.

2) The establishment of rules requiring that records be kept concerning the actual percentage of time that grant-supported scientists devote to a research project.

3) The interpretation that full-time employment with funds derived from a research grant should prohibit even a modest and sensible participation of scientists in such regularly scheduled
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educational activities in an institution as are conducive to the scholarly development of the individual.

4) Restrictions upon freedom to shift funds within the several budgetary categories of a research grant, even when a grant has been morally committed for several years in advance, with those inevitable changes in orientation that develop and that require a maximal amount of flexibility in the management of research funds.

Let us consider then, each of the above-listed restrictive regulations, and some constructive suggestions for their modification.

1) Scientists reacted vigorously against a most objectionable earlier restriction that prevented any significant modification of an initially approved research objective by a qualified investigator. Their objections led the Surgeon General of the PHS to announce recently a change in this regulation whereby the alteration of research objectives is now limited to "changes in methodology, approach, or other aspects of the project that would expedite achievement of its (my italics) research objectives, including changes that grow logically out of the approved project and serve the best scientific strategy." This is a major step forward, but even this statement does not go far enough, for it does not permit an essential change in the orientation of a very competent and established investigator. All that is needed, in this new regulation, is to change the italicized word "its" to "his." Such a modification would put the responsibility for quality and objectives where it should be, in the hands of the carefully selected investigator. Furthermore, it would have the very salutary strategic effect of not encouraging the submission of grant applications that are vague with respect to objectives and therefore difficult to evaluate. It would thus be recognized that precision in the delineation of a proposed investigation, although of great value to advisory committees concerned with evaluation, would not restrict an investigator to an area that new research could demonstrate to be unproductive.

2) Perhaps none of the new regulations has caused more irritation among scientists than has this one; not only is it unrealisitic and unworkable, but it demands intellectual dishonesty. Good investigation cannot be done under the shadow of a time clock and effective scientists do not work a week of 37.5 or 40 hours. A regulation that requires that either "per cent of time" (or "per cent of effort") or "hours per week" be recorded asks for the impossible. Contributions to research cannot be estimated on the basis of the number of hours at either the bench or the desk, for equally important intellectual contributions actually may occur during conferences with scientific colleagues and students, and, even more, with time for reflection: in the library, while shaving, or in the quiet of one's bed! Let us realize, therefore, that neither time nor effort can be gauged as with clerks, and scientists should not be required to make outwardly plausible but actually untenable estimates of it.

3) There appear to be some curious differences between the kinds of dollars awarded by the PHS in support of research and training and how they may be used; these may be defensible in terms of bookkeeping and "fiscal control," but not in terms of attainment of intellectually desirable goals. Thus, as an example, a PHS research grant that fully supports a scientist permits him to give only an occasional unscheduled lecture, but a modest amount of scheduled teaching, desired by the individual for his own intellectual stimulation and growth, the respect of his peers, and the development of his career, is forbidden. On the other hand, the same man might be employed legally, and on a full-time basis, on a PHS-supported research training program and be so overburdened with teaching that time for productive research would be minimal or absent.

Clearly, a much more liberal interpretation is needed of what is reasonable in the way of modest and sensible participation in teaching that is desired by the theoretically full-time research worker, and of what actually is beneficial, not detrimental, to his research. To accomplish this requires only a common-sense definition of reasonableness—and what could be simpler than an average participation of up to perhaps 6 hours a week, rather than, let us say, up to 15 percent of his time and effort?

4) Some restrictions upon freedom to shift funds, within the various budgetary categories of a previously approved grant, would seem to be entirely warranted if scientists are not to be regarded as the best judges of sensible and productive ways to obtain desired objectives within the framework of the
total amount of money provided for the conduct of their own research. But if the scientists are not to be trusted, who is? As the new rules now stand, it can be predicted that a rapidly expanding army of bureaucratic officials will be drafted to rule upon the multitudinous and laboriously documented appeals for budgetary readjustments that are certain to be presented continually by grantee scientists throughout America. Who can evaluate and rule upon these appeals? Presumably former scientists who, for a variety of reasons, become involved in the regulation of science rather than in contributing to it creatively. Will not the amount of money relegated to the salaries of this new bureaucracy, as well as the amount of time spent by scientists who ought to be working or thinking, be far more wastefully expended than that to be spent, presumably unwise, each year by a small percentage of less severely controlled grantees? If the fear is that some institutions will use research funds to rehabilitate physical facilities (or in some other wasteful manner), presumably with a view to the better accomplishment of the research, will this not be controlled adequately by the well-known activities of the General Accounting Office, which scrutinizes the records of expenditures by institutions and has the power (and exercises it) to enforce restitution? If undue travel by scientists for conferences and the exchange of ideas is a legitimate and really fearful problem, a restriction on alterations of this aspect of research budgets perhaps is defensible. It would seem, however, that in all other categories the best way to foster scientific progress is to delegate authority to the principal investigator (and his administrative associates in an institution) to expend the allocated research funds with maximal freedom. The investigator, as an applicant, has already been judged to be highly qualified for the conduct of research; a reasonable sum of money has already been granted with which to gain the desired objectives, and maximal attainment will occur only with minimal bureaucratic interference in the guise of attaining fiscal responsibility.

In conclusion, it is suggested that the objectives of the Congress to further scientific research and the training of new scientists, as well as the best means of attaining these ends for the public good, hitherto attained with remarkable success by such disbursing
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and Evolution (1), Ernst Mayr devotes a chapter to the evolution of man in which he supports the view of Julian Huxley that the frequency of superior combinations of alleles in the collective pool of human genes has diminished and is probably continuing to do so. The assertion applies especially to human intelligence and is based on (i) fossil evidence of long-term changes in cranial capacity, indicative of an early period of rapid evolution of mental ability which apparently came to an abrupt halt, and (ii) the much discussed negative correlation between I.Q.’s of school children and family size. As a remedy for this supposed trend, Mayr proposes the introduction of financial changes, involving the manner of taxation and the payment of educational fees, to encourage (rather than to deter as they now do) procreation by, and the education of, gifted people.

Even if the evidence for a decline in the genetic basis of intelligence were generally accepted as adequate (which Mayr recognizes is not the case), many geneticists would still be inclined to wonder just what they personally should do about a problem which can seem at one and the same time terribly important and yet, perhaps, not very urgent.

Probably only a minority, even among geneticists, feel reasonably sure that there is such a downward trend. Experts called upon to advise the British Royal Commission on Population (2) have pointed out a number of deficiencies in the evidence, and recent limited data have done little to support the view that a decline is, in fact, in progress (3, 4).

Interpretation of the seemingly unfavorable fertility differential is far from simple. (i) Childless members of the parental generation, who are not ascertained in studies of the I.Q.’s of school children, may be predominantly of lower-than-average intelligence (4). (ii) Children with many brothers and sisters may develop more slowly than other children so that they underrepresent their parents’ intelligence. (iii) A similar negative correlation has been observed in the Scottish Mental Survey (5) between sibship size and height (and also weight) which, by the reasoning applied to intelligence, would seem to indicate a decline in the frequency of superior gene combinations for stature—an interpretation which is difficult to reconcile with the dramatic increase observed in stature. Nevertheless, a continuing attitude of concern

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for man's genetic future must be regarded as essentially healthier than one of smugness based on present ignorance.

To hope that the biological aspects of man's evolution will be "duly taken into consideration by those entrusted with the task of planning the future of mankind" (1, p. 662)—if by this is meant the elected representatives of the people or the civil servants whom they control—seems either unrealistic or else positively dangerous as long as geneticists themselves are not in some sort of general agreement.

Let us suppose, however, that the reasoning and the inference are correct, although still unproved, and that all that is required in order to achieve unanimity of opinion on the urgency of the matter is adequate evidence. How much effort would be justifiable, under these circumstances, in an attempt to obtain such evidence in spite of known substantial difficulties? A major defect in most studies so far, which will have to be remedied in future undertakings, is that the negative correlation of I.Q. test scores with family size has been investigated in only a single generation of tested individuals—a procedure that must be regarded as inherently unsuitable for distinguishing between a genetic and an environmental component in intelligence. More elaborate studies will, of course, be much more demanding in their requirements.

While it is generally recognized that the first step in detecting the supposed genetic trend would have to be the devising of methods by which mental capacity or performance can be partitioned into a heritable and a non-heritable fraction, the unlikelihood that a strictly psychological test will ever do this has not been especially emphasized. Certainly no physical test is envisioned which would partition stature into a heritable and a non-heritable fraction, and intelligence may well be much the same. The only sound method in either case would seem to be a breeding test.

For intelligence, this would have to take into account not only the I.Q.'s (or other measures of performance) of the parents, but also various assessments of the degrees of social adversity against which these I.Q.'s were achieved. To identify a transmissible component, it would then be necessary to observe the I.Q.'s of the children as developed under known degrees of social adversity.

Even this does not represent the ultimate in refinement and must be regarded as just one more step in the quest for discrimination. True, it will distinguish a transmissible component from one conditioned by an environmental factor which has been newly injected into the family history. The further distinction, however, between transmission by genes and that which takes place as a result of family traditions and habits is more difficult, although it must not be regarded as wholly impossible. Curiously, neither the suggested obvious improvements in design, nor possible further refinements, have been explored in any detail, even in discussion. Haldane suggested to the Royal Commission on Population that a two-generation approach was needed, but neither he nor any of the other advisers mentioned details. It would almost seem as if the organizational and financial difficulties in a two-generation study of appropriate design and size have caused the geneticists to renounce their own special kind of test (that is, the breeding test) in favor of something they have hoped the psychologists might devise, but which will probably never materialize. One could probably defend even the extreme opposite view that a very bad test of performance, when used in a suitable two-generation study, is superior to the most refined test of performance when used in any single generation study.

Two generations of I.Q. scores, specific for families, are in fact available from the investigation being carried out at the Dight Institute (4) but measures of social adversity are lacking. This project is small in comparison with what would be required to detect correlations of fertility with the heritable component of intelligence, as assessed by a two-generation approach incorporating refinements of the kinds mentioned earlier, although it is considered large by most standards since it includes records of over 80,000 people. Size can be critical where precision is required, and especially where a number of variables are to be considered.

A more appropriate scale might even approach that of the Scottish Mental Survey (in which about 80,000 children, 11 years of age, were tested in a single year), but the test would be repeated annually to build up family histories, including social particulars, spanning two generations. This would be exceedingly laborious unless use were made of the large amounts of data on intelligence that are already being gathered routinely by most schools (as was done to a limited ex-
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tent in the Dight Institute study) and of such information on family size and social characteristics as is collected by the vital statistics system.

An undertaking of this kind would become possible only through rapid handling and compact storage of the large quantities of data, and through use of an appropriate technology for linking up successive records relating to the same individuals or families (6). Under such conditions, however, it would become less laborious to follow all the families in a geographic region by using the routine records, than to follow a 1-percent sample by personal interview and correspondence. A study involving 50,000 to 100,000 records per year might correctly be regarded as large, but it seems less so when it is pointed out that a central office of the Canadian Pacific Railway receives a similar number of records of freight car movements each night and uses them to update a master file of freight-car histories for accounting purposes.

For any large two-generation study of family histories full-time effort on the part of one or more senior research scientists would be needed, in designing and testing procedures, arranging for use of existing records of I.Q. test scores and family relationships, and ensuring continuity and flexibility in the running of the project over a period of 30 years or more. Other costs might equal the salaries, or be even greater. Nevertheless, I.Q.'s of children are measured by most schools routinely, and family relationships are unambiguously recorded in the vital statistics registration system together with some social data. Thus, we have hardly begun to use the vast amounts of relevant information we already possess and much of it (relating chiefly to the I.Q. scores) is systematically destroyed after a limited period so that if not used currently it may be irretrievably lost.

Mayr's reasoning, like that of Huxley and others, is largely divorced from questions of detailed design and costs of relevant scientific studies. Perhaps, after all, the effort required would be too great in view of present uncertainties about the extent of the refinement that might be achieved even with the best of planning, difficulties in interpretation that might still remain, and the nature of other important competing demands for funds and scientists. But what, then, is the degree of importance associated with the problem raised by Mayr? He has suggested reallocation of taxation and educa-

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tional costs involving many billions of dollars even in a single lifetime. If the matter is really that important, who should be doing the detailed thinking about the next step towards an ultimate demonstration of the presumed deleterious trend?

Perhaps consideration should also be given to the possible genetic effects of legislative changes of the kinds recommended by Mayr, irrespective of whether the frequencies of "superior" gene combinations are decreasing. Would such measures lead to any substantial increase in their frequencies, and is this desirable? These questions could, presumably, be studied by following appropriate sub-groups within a population, but how much thought and effort are such studies worth?

HOWARD B. NEWCOMBE
Biology Branch, Atomic Energy of Canada, Chalk River, Ontario

References

That 1953 Fallout

E. J. Sternglass refers to the fallout in 1953 in the Troy-Albany area in his report "Cancer: Relation of Prenatal Radiation to Development of the Disease in Childhood" [Science 140, 1102 (7 June 1963)]. He assumes that there would have been a significant dose to the bone marrow of the human embryo because of radioisotopes ingested by the mother with fresh milk and vegetables.

As I pointed out in a previous comment, upon a report by Ralph Lapp [Science 138, 732 (9 Nov. 1962)], the 1953 fallout in this area occurred on 26 April 1953 and the average date of first pasturing in the area was 12 May, 17 days later. There was a total of 5.36 inches (13.6 cm) of rain during the period between the deposition of the

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fallout and the date of first pasturing. Therefore it would seem that the amount of fission products ingested by a milk-drinking, pregnant woman subsequent to 12 May would have been very small indeed.

There could have been little ingestion of fission products with leafy vegetables, for only asparagus was grown and marketed before June 1953 in this area. Asparagus was first harvested on 10 May, according to the records of a representative market gardener.

The cancer report files of this department reveal no increase in the incidence of cancer or leukemia over the past ten years in children of the Albany, Troy, and Schenectady areas—who were 15 years of age or younger in 1963—as compared with children of this age elsewhere in upstate New York.

**JAMES H. LADE**
New York State Department of Health, Albany

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**Fluorescence Microscopy:**

**Use in Intracellular Microscopy**

Bullock, in his paper on "Neuron doctrine and electrophysiology" [Science 129, 997 (1959)], calls attention to the difficulty that intracellular micro-electrodes must be placed blindly because a tiny glass tip is invisible in a medium of high refractive index. *Science* publishes numerous reports on intracellular micro-electrode studies, and some of those working in this field might find it worthwhile to try using fluorescence microscopy with electrodes of a fluorescent glass such as uranium glass or a rare earth glass. Since a fluorescent object is self-luminous, objects of any size and any refractive index can be seen if fluorescence emission is adequate. With preparations thin enough for stage illumination, cells can be made visible by combined phase and fluorescence microscopy [Price and Christenson, *Mikroskopie* 12, 14 (1957)—(no reprints left)]. Thicker specimens can be observed with an incident light microscope, with cells made visible by a fluorescent dye such as acridine orange, which has been used for vital staining of nerve tissue by, among others, Zeiger and Harders [Z. Zellforsch. Mikrosk. Anat. 36, 62 (1951)].

**GEORGE R. PRICE**

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