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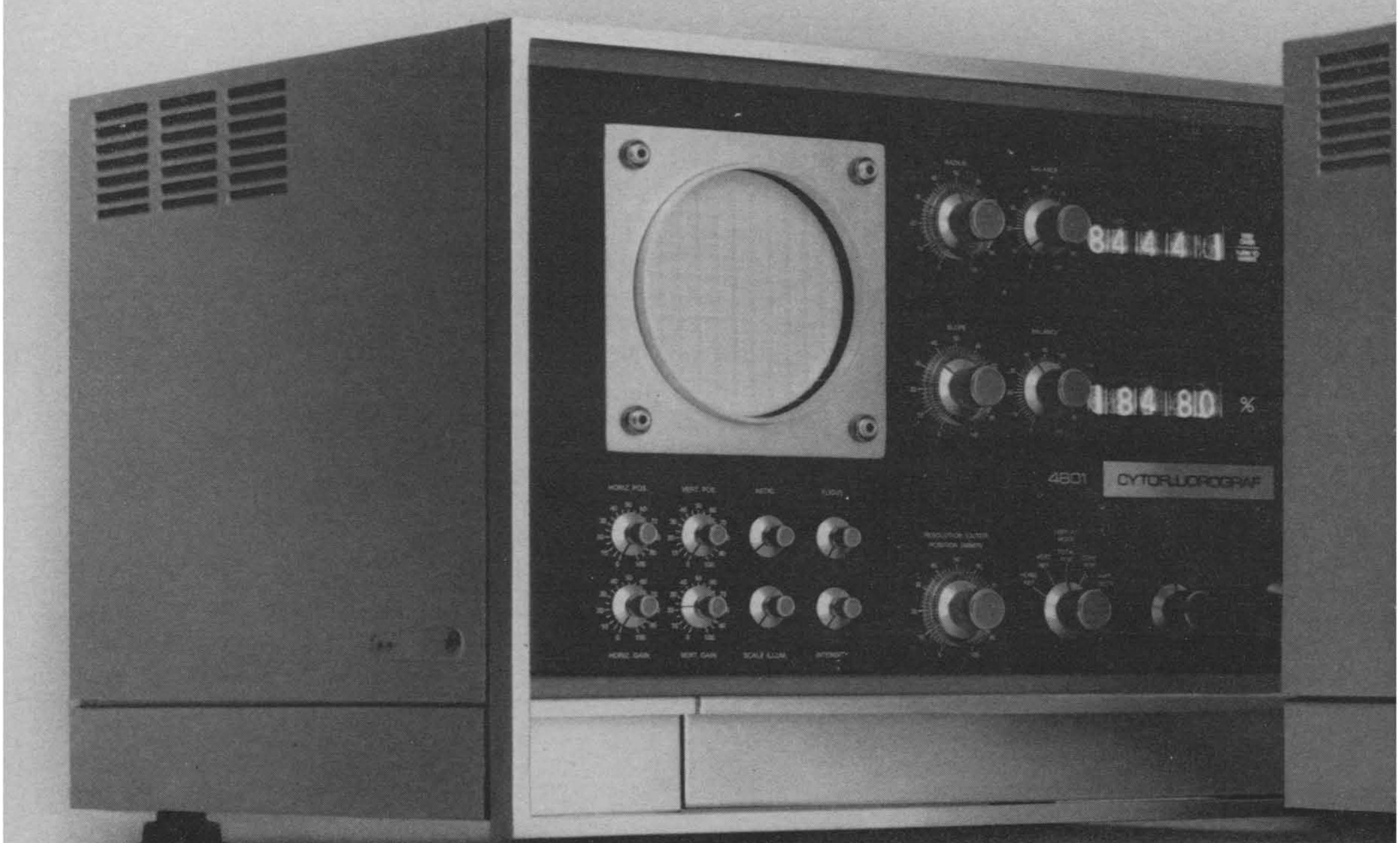
COVER

Well-known example of an ambiguous figure ("the mother-in-law"), by the late E. G. Boring. It may be seen as a fashionable young woman or an ugly old one. Reproduced in R. L. Gregory's *The Intelligent Eye* (reviewed on page 365). [McGraw-Hill Book Company]

Bio/Physics Systems proudly announces: two exciting new instruments for automatically measuring, differentiating, counting, and characterizing individual cells, cell constituents or particles.



The Cytograf and Cytofluorograf are the subject of pending patents.

Some things are changing for the better.

A practical way to automate a GC lab . . . one step at a time

Although gas chromatographs (GC's) are designed and built for around-the-clock operation, the majority of them are used only a few hours each day . . . and never on Sunday. There are always good reasons for such under-utilization of expensive equipment. In this case, it's a matter of manpower: some one has to be present to inject a new sample into the GC; and every time an analysis is completed, some one has to spend about a half-hour translating the analog data of the recorded chromatogram into a meaningful quantitative analysis. Since most GC laboratories operate on a 40-hour week, it simply has not made good economic sense to add a second and third shift simply to realize a fuller utilization of the GC's.

But that's no longer the only solution. Some new instruments have recently appeared on the scene that allow you to triple the analytical output of your GC lab without increasing your staff or number of GC's. And you can do it a step at a time, as your budget allows, each step fully compatible with the next one.

First there's the 7670A Automatic Sampler. It measures and injects samples into your GC, completely unattended. The impact of the 7670A on the productivity of your lab can be dramatic: a single chromatographer can prepare samples and load them into the 7670A thirty six at a time, keeping the GC productive around the clock, even over weekends. Assuming a half-hour cycle per sample, he can produce well over 200 analytical runs a week, easily three times his best output with manual injections. If you're wondering about the reliability of the 7670A, don't. We have repeatedly performed 24,000 continuous automatic injection cycles with it in our laboratories—the equivalent of more than two years of unattended operation—without a failure. As an unexpected bonus, you'll also improve the quality of your laboratory's output because the 7670A's machine-reproducibility is consistently more precise than a skilled technician. Cost is $2850.

Then there's the 3370A Integrator. It automatically quantitates the GC analysis, prints an area count for each peak on the chromatogram and a total area count for the analysis, if desired. This cuts the chromatographer's computational load by about 10 minutes per sample (the time that it takes him to make area measurements manually). Apply this to a 7670A-equipped GC capable of producing 200 analyses a week, and you eliminate more than 30 hours of computation time . . . enough to pay for the 3370A, which costs $4950, in about four months. And you'll enjoy a further marked improvement in the precision of your GC analyses.

Next step in this modular approach to automation is the 3360A GC Data Processing System, an on-line data handling system whose HP 2114B Computer is fully programmed for GC. It processes data simultaneously from up to eight GC's equipped with 3370A integrators and automatically prepares a typewritten report of each analysis, including the name, retention time and % concentration of each component. The 3360A thus completely eliminates manual computation, cutting an additional 20 minutes per sample from the chromatographer's load (the time that it takes him to compute component concentrations manually and prepare a final report). To understand the potential impact of the 3360A on your GC lab, two additional facts must be kept in mind: the cost of the 3360A to a laboratory that has eight GC's already equipped with 3370A integrators is not $100,000 or $50,000, but less than $20,000 installed; and the 3360A is theoretically capable of processing more than 6000 analyses per month. Even if we assume that it will be used for as few as 1000 samples monthly, the 3360A will eliminate more than 300 hours of computation time from your manpower budget, enough to pay for the entire cost of the system in little more than 6 months.

Finally, for laboratories whose sample load does not exceed 500 per month, there's an even more economical way to automate data handling. By adding a hardware-plus-software option to your 3370A Integrator, you can automatically produce a computer-compatible punched paper tape record of integration data. You then feed the punched paper tape off-line to any of the principal time-share computers, using the BASIC language program provided, and automatically receive a complete report of the analysis, as with the 3360A. This cuts some 17 minutes of computation time per sample (in addition to the 10-minute reduction from the 3370A proper) . . . or a savings of some $1400 monthly based on a 500-sample load. Considering all costs—the $1550 cost for the 3370A option and the variable costs of the time-share computer lease—payout takes less than six months.

If you care to study in more detail the economics of HP's step-by-step automation for your GC lab, write for the Fall 1970 issue of *Analytical Advances,* a 32-page study of the subject.

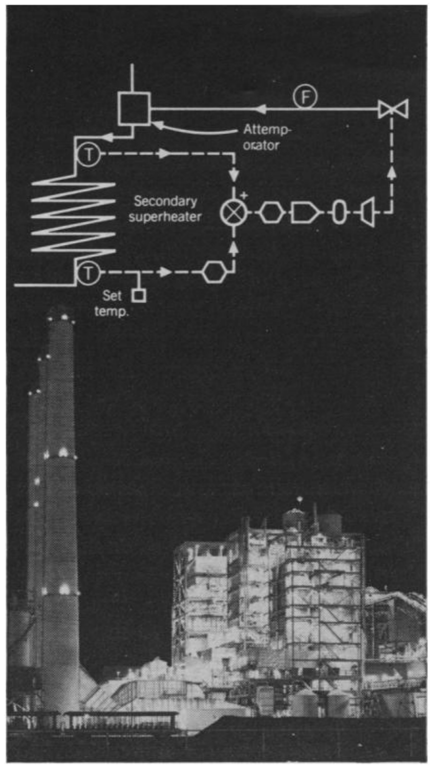
New tool for on-line control system analysis

(Note: To our Scientist Readers: The subject of the following article is a new instrument for continuous signal analysis that is useful in medical research, acoustics, radio astronomy and many other scientific measurements as well as in the process control application described.)

Very recently at a large power station in England, a system analysis of an attemperator (temperature control) loop was completed on-line, without disturbing plant output in any way. As the control characteristic of the loop was displayed on a screen during the experiment, adjustments were made to optimize control system response and the results were displayed immediately.

The job of the control system engineer—to predict how the system will react to a given input pulse—has not always been so easy. If he tested the system with a large enough impulse to produce a measurable response, plant output was changed in a way that could not be tolerated.

Some progress was made when control system analysts discovered the power of cross-correlation. With this mathematical technique, a test noise signal is applied to system input at such a low level that system output is not changed beyond normal background disturbances. Yet by cross-correlating



the test noise with system output over a relatively short period, the engineer is able to extract the impulse response of the system; background disturbances do not interfere because they are uncorrelated with the test noise. At first, cross-correlation did not help because it could only be accomplished after the fact, through off-line digital computation. What made the difference in the English experiment was the availability of two new HP instruments: a Model 3721A on-line correlator that's about as easy to use as an oscilloscope, and a Model 3722A precision noise generator that synthesizes repeatable pseudo-random noise, ideally suited to system analysis.

Correlation is fundamentally an averaging technique that is a powerful tool in recovering all kinds of periodic signals that are buried in noise, and in establishing a relationship between apparently unrelated signals. With the 3721A, the technique is easily applied *on-line* for continuous signal analysis in many kinds of scientific measurements. It might be useful in your work too. The Correlator costs $8325 and the Noise Generator $2650. On request, we'll be glad to send you a packet of information on these two instruments and a 96-page booklet on Discrete Signal Analysis.

Acquire and reduce scientific measurements automatically . . . without a computer

If you're a typical scientist, you spend a lot of time on the bench making measurements . . . and you don't object to that at all. What you do mind is the ever-increasing amount of time that you must spend at the desk making the calculations that turn raw measurements into useful information. Some scientists still rely on slide rule and adding machine for this work; some have acquired a 9100 Computing Calculator and, in one economical stroke, cut their computational load by half or more.

If you're in the second group, we'd like to tell you of a new way to liberate even more of your time for scientific investigation, by letting your data gathering instruments communicate directly with a data processing system. You might think that this will necessarily involve you in the cost and complexity of a computer.

Not so. With the new HP Coupler/Controllers, you can now tie many measuring instruments to the 9100 and get reduced data directly . . . from more than 40 HP digital instruments including voltmeters, frequency and time counters, nuclear scalers, quartz thermometers and GC integrators.

You can even connect a teletypewriter to them and get a complete report

of your experiment, formatted as you like it and prepared automatically on a typewritten sheet, punched paper tape or even on the calculator's X-Y plotter.

We'd be happy to send you bulletins that explain how you can expand the capabilities of your 9100 for on-line data handling and even for automatic test systems. Write for "Calculator-Based Instrumentation Systems." Couplers are priced at $1275 or $1875; interfaces cost $450 to $1775 per device.

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Measurement, Analysis, Computation

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Higher Education and the Nation's Health

Before the turn of this century, the American Medical Association (AMA) had begun to root out quacks and nostrum producers and to expose the deficiencies of proprietary interests in medical education. With AMA support, the Carnegie Foundation commissioned Abraham Flexner to report on the state of medical education. His recommendations in 1910 revolutionized medical education by establishing it as a full and proper function of the university.* Proprietary medical schools were driven out of business, and the AMA's Council on Medical Education helped to set and enforce the new standards of accreditation.

Advances in medical science and technology have proven the wisdom of the Flexner Report. These successes have produced rising expectations, and rising costs have inevitably followed. Nonetheless, health statistics belie our massive expenditures on health services. We find ourselves with a severe shortage of medical manpower and with an inability to utilize optimally our hard-won knowledge. A profound disarray characterizes the financing of universities and medical schools. A renascence of anti-intellectualism (or anti-science) is now compounding the problem.

The Carnegie Foundation has once again entered the fray. Its report† notes that "the Flexner, or *research* model" with all its tremendous benefits has produced two major weaknesses: (i) expensive reduplication of scientific effort between medical school and parent university; and (ii) neglect of the problems of utilizing medical knowledge and of the public issues of cost, quality, and accessibility of health services. The report applauds recent efforts of some medical schools to extend themselves into the community to develop new "health care delivery models" and to develop "integrated science models" in the university. It recognizes the need for increased numbers of doctors, dentists, and allied health personnel, and for regionalization of health services.

The report recommends the development of more university health science centers and of 126 area health education centers that would be affiliated with the health science centers for the purpose of providing regional training and of making high-quality services available. It calls for increased federal and state support for private medical schools but suggests that costs can be reduced and manpower increased by reducing medical school requirements from 4 to 3 years and doing the same for residency training. In addition, combining science in the medical school with that on the university campus, reducing the faculty to student ratio, admitting two classes a year, teaching during the summer, and having a minimum class size of 100 to effect economies of scale, and, finally, increasing the numbers of allied health personnel to increase the productivity of physicans are rational and laudable recommendations.

Unfortunately, the report has been perceived as blaming scientific advance for the social problems surrounding the delivery of health services. This nation would be better advised to heed the caveat that knowledge does indeed cause trouble but that ignorance causes far more.

Exceptions must be taken to some parts, but, overall, the report is comprehensive and rational. We have enough reports. We must have action. Medical and other university faculties, practicing physicians, and responsive state and federal governments must all play a part in the resolution of the issues. The time may be shorter than we think.—JOHN H. KNOWLES, *General Director, Massachusetts General Hospital, Boston*

* A. Flexner, *Medical Education in the United States and Canada*, A Report to the Carnegie Foundation for the Advancement of Teaching (Merrymount Press, Boston, 1910).
† *Higher Education and the Nation's Health: Policies for Medical and Dental Education*, A Special Report and Recommendations by the Carnegie Commission on Higher Education (McGraw-Hill, New York, 1970).

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