SCIENCE

4 August 1961

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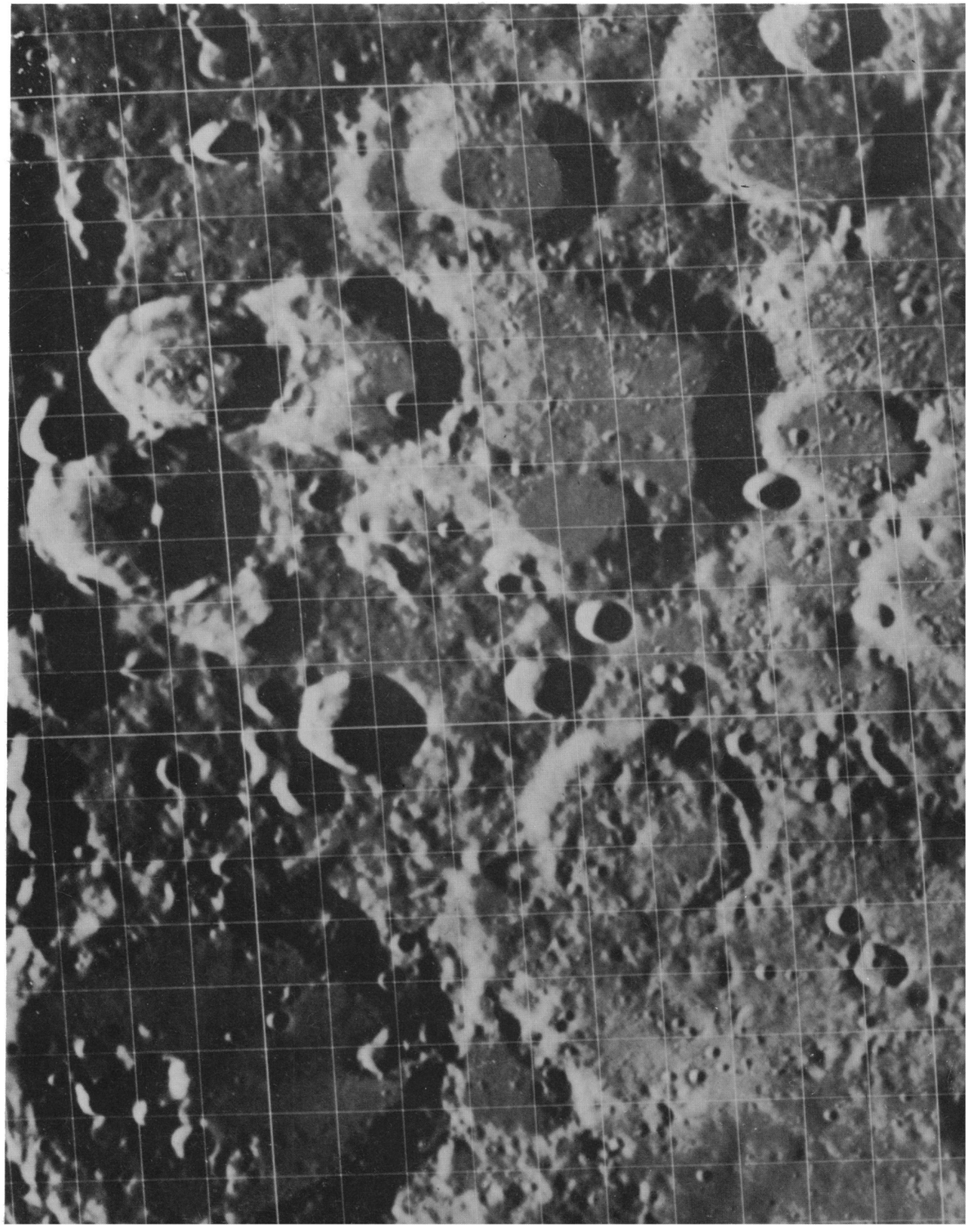
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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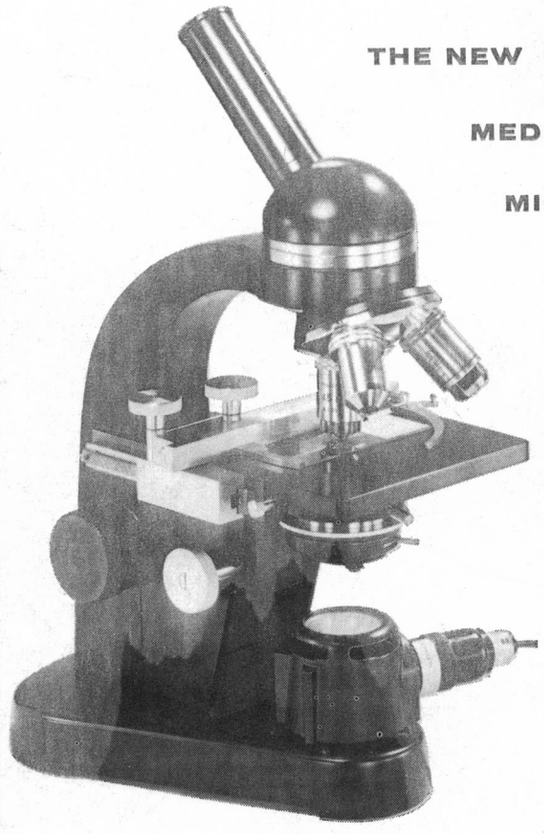

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4 August 1961, Volume 134, Number 3475

SCIENCE

Basic Research at Honeywell
Dr. Finn Larsen
Vice President for Research

Thermal Radiation: Studies In Emittance And Reflectance Properties of Materials

Because of possible high temperatures and the absence of an atmosphere, radiation becomes the primary method of heat transfer in space. Current interest in space exploration makes it mandatory to accurately determine the reflectance and emittance of various materials. Honeywell scientists have developed new techniques that promise useful new data on this method of heat transfer.

Heat transfer can take place in only three ways: convection currents, conduction, and radiation. Radiation becomes increasingly important to scientists because, at high temperatures or in a vacuum, it is the predominant or possibly the sole form of heat transfer. An understanding of radiation is particularly important today as man looks ahead to space travel. In space the vacuum exists, and high intensity heat radiation will be encountered.

In discussing heat transfer by radiation, clear terminology is important. Reflectance refers to that fraction of incident radiation that is reflected. The remaining fraction not reflected is absorbed when it strikes an opaque body. When given a numerical value it is called absorptance, and if the surface is at the same temperature as the radiator, absorptance is exactly equal to emittance. Emittance is the amount of energy emitted by a body related to the energy emitted by a perfect emitter given a value of unity. Thus, if reflectance (ρ) equals x, then absorptance (α) equals 1—x. And under conditions of temperature equilibrium, emittance (ϵ) also equals 1—x.

In transferring heat through radiation, the reflectance and emittance of surfaces determine the amount of heat transferred, and the understanding of emittance becomes the key to the heat transfer problems occurring in space.

Complicating our understanding of emittance is the fact that emittance is a function of the temperature of the surface under consideration. Also, emittance varies with the wave length of radiation.

The problem in the study of emittance over the years has been the inability to obtain consistent data. Various authorities have reported widely differing results. Contributing to these differing results is the inability to specifically describe identical surfaces and to repeat identical experimental conditions.

Additional problems complicating the ability to make comparable quantitative measurements are:

1) Energy from surrounding extraneous bodies is often reflected.
2) The measuring instrument cannot differentiate between reflected and emitted energy from the test specimen.
3) The amount of energy emitted varies with the angle of incidence with respect to the surface of the specimen.
4) Slight impurities can change the emittance characteristics of the specimen.
5) The atmosphere absorbs energy, thus the atmospheric pressure under which the observations are made is significant.

Honeywell scientists, however, have developed a new technique that avoids most of these problems. Their approach is to measure the spectral reflectance from which they can calculate spectral emittance. Total emittance and, therefore, total absorptance can be calculated by integrating spectral emittance.

Prior to the development of this technique, only a limited range of the spectrum could be measured by a single procedure. Different techniques and equipment were necessary to measure the remainder of the spectrum. The resulting multiplicity of procedures and equipment frequently introduced discrepancies.

With the Honeywell technique, monochromatic energy from an infra-red spectrometer is beamed on a diffuse reflector surface. The diffuse reflector is located at one of two conjugate foci of a highly reflecting integrating hemisphere. The energy is reflected by the diffuse reflector to the hemisphere. The hemisphere collects the energy and focuses it on the specimen located at the adjacent focus. Some of this energy is reflected out through a small port in the hemisphere to a sensor.

A complex equation involving the unknown reflectance and the known reflectance of a previously determined reference makes possible the calculation of the reflectance of the specimen.

It is possible to measure reflected energy in the presence of emitted energy, since all energy entering the system from the monochrometer is "chopped" at 13 cycles per second. Thus, energy reflected will also be at 13 cycles per second while inherently emitted energy will be continuous radiation.

Honeywell's apparatus and technique represents extensions of earlier work in the field. They are unique, however, in combining a monochromatic beam, an outside sensor, and a hemispheric reflector.

An important immediate result of the work done by Honeywell scientists is the ability to determine the specific emittance characteristics of different anodizing techniques for several different metals. Thus, accurate specification of an anodizing technique will predetermine the desired emittance. Ultimately it will permit specification of the entire surface of a space vehicle, allowing it to operate at predetermined temperature ranges in space. There are also several important industrial processes to which such knowledge would bring substantial improvement. Honeywell has as an eventual goal the control and adjustment of emittance in flight.

If you are engaged in scientific work relating to emittance and reflectance, and would like to know more about Honeywell's research, you are invited to correspond with Mr. J. E. Janssen, Honeywell Research Center, Hopkins, Minnesota. If you wish a recent paper by Mr. Janssen, write to Honeywell Research, Minneapolis 8, Minnesota.

traced not to the motives of the American people but to the motives of the people we send out to administer our foreign programs. We technicians may know how to work with people, but the administrators, mostly political appointees, know only how to work people in order that the sinecures garnered may be perpetuated. They survive chiefly because there are counterpart bureaucrats in the host country who have similar motives. The results are tragic both for the American taxpayer and for the natives he is trying to help. Another tragic consequence of the American political spoils system is the high regard native people begin to have for the Russian approach to their problems. This was described in the New York *Times* of 5 January 1960 by W. W. Kenworthy. He discussed the direct approach of setting up projects with specific objectives scaled to the understanding of the natives involved, as opposed to the grandiose million-dollars-be-damned approach of the Americans. The Russians try to impress the people affected; the Americans too often play to the politicians, whose prestige often depends upon how much they can squeeze out of Uncle Sam.

Instead of teaching people, I think we should merely allow them to learn at their own pace and in their own way. After all, as the people we want to help know so well, a way of life cannot be taught, it can only be lived.

MILTON D. LOWENSTEIN
Arizona State University, Tempe

Man on the Moon

It has, apparently, been decided that we shall be remembered as the only nation in history that felt that it could spare $9 billion—but could think of nothing better to do with it than to shoot it at the moon.

There has been remarkably little criticism of the proposal to put a man on the moon. Perhaps everyone is convinced that this is the supreme proof of our faith in science, and that it will be the final demonstration of our competence as scientists. It is not obvious, however, that science will, in the long run, benefit by being identified so closely with grandiose schemes whose real sponsors are the military hierarchy and the missile builders. Any layman or scientist should be able to name at least a hundred better ways to spend the money, and our more sophisticated friends abroad are apt to regard the project less as an affirmation of national determination than as a declaration of intellectual bankruptcy.

Just as a timid suggestion, why not have the AAAS sponsor a contest in which each bright young graduate would list the ten best ways to spend $1 billion.

WILLIAM PALMER TAYLOR
416 Ross Avenue,
Hamilton, Ohio

"Mad-Baiting"

The increasing interest in mental health these days seems to be associated with a rather significant, albeit comparatively unnoticed, political phenomenon—the phenomenon of "mad-baiting." There even seems to be some evidence of this phenomenon in the situation described in your "Mental health in the House Rules Committee" [*Science* **133**, 1468 (12 May 1961)], even though the conclusions are certainly sound.

In "mad-baiting," scientific evaluation of ideas, and of disturbing ideas in particular, is avoided by labeling their promulgators "mad" or "disturbed." Sometimes technical diagnosis, often from afar, lend a veneer of scientific credibility to such *ad hominem* attacks on ideas. Instead of being soberly examined, ideas of this sort are then either ignored or else fought with blind fury, as though the devil himself had created them. Which response actually occurs in a given situation is likely to be determined much more by unthinking, popular attitudes, often prejudicially shaped by the mass media, than by the nature of the ideas themselves.

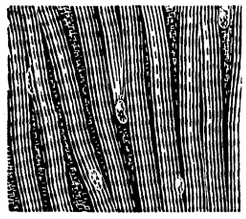
Scientific method demands, however, that ideas be carefully examined and soberly responded to on their own merits. Only after an individual's ideas have been repeatedly shown to be consistently wrong are we entitled to begin to question either his motives or his stability; even here, however, the term *sick* begs the basic question of whether the errors are accidental or, as with Adolph Hitler, deliberate lies.

Name-calling is an old political tactic. A new pseudoscientific veneer to either "mad-baiting" or "red-baiting" in these psychologically oriented days should not prevent us from recognizing its basically obfuscatory function, and its antidemocratic and antiscientific effect.

NATHANIEL S. LEHRMAN
15 Canterbury Road,
Great Neck, New York

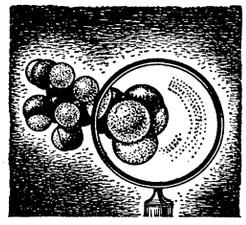
IT HAPPENED THIS MONTH...

a glance at yesterday in relation to today



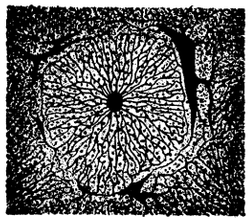
IN AUGUST — (1798) — *Philosophical Magazine* speculates upon the nature of muscular contraction. "It appears very certain that the cause of muscular movement is owing to the nerves . . . But how does the nerve move? Some philosophers have compared its movement to the oscillation of an extended cord which is struck: But, 1. The nerves are not extended: 2. They are enveloped on all sides; whereas the cord has no points of contact but at its two extremities. It appears more probable to others to consider the nerve as . . . a series of vehicles in which flows a fluid called the nervous fluid. I have supposed that this nervous fluid is of a nature analagous to the *aura feminalis*. Others have fought for the cause of irritability in electricity, and the experiments in Galvanism seem to give some weight to this opinion."[1]

Now, a century and a half later, there are still many unanswered questions as to the nature of muscular contraction. There is general agreement, however, on the importance of ATP as the source of chemical energy for muscular movement. Schwarz has long played a leading role in providing ATP and other biochemical phosphates involved in energy transfer reactions — ADP, adenylic acid, adenosine-3′:5′-cyclic phosphate, GTP, GDP, CTP, and CDP. Some of these compounds are available in radiochemical form. In addition, we supply dehydrated firefly tails for precise and specific micro assay of ATP.



IN AUGUST — (1938) — a report from Paris provides insight into the role of sulfhydryl groups in enzymatic activity. It is suggested that changes in the activity of the enzymes may be attributed to oxidation and reduction of SH groups. Rapkine[2] has shown that oxidized glutathione inactivates the enzyme catalyzing the oxidation-reduction reaction between triosephosphate and pyruvate. If the excess glutathione is dialysed away, the enzyme can be reactivated by reduced glutathione or cysteine, the latter being more rapid in its action.

Today, enzyme chemists use sulfhydryl compounds routinely to activate a large number of enzymes. Toxicologists are interested in them as protective agents against radiation, nitrogen mustard, and other metabolic poisons. Glutathione was the first compound made and sold by Schwarz over twenty years ago. We have been interested in sulfhydryl compounds ever since, and now offer oxidized and reduced glutathione, cysteine, cystine, homocysteine thiolactone, thiolated gelatin. Some of these compounds have been labeled with S^{35} or C^{14}.



IN AUGUST — (1953) — a group of Scottish investigators[3] discusses the incorporation of N^{15}-glycine, C^{14}-formate, and S^{35}-methionine into the nucleic acids and proteins of rat liver cell nuclei and cytoplasmic fractions. Nuclear DNA incorporated C^{14} and N^{15} at a slow rate, but nuclear RNA showed greater activity than the RNA of mitochondria, microsomes, or cell sap. With all three isotopes there was no great difference between rate of incorporation into nuclear and into cytoplasmic protein. This indicates that nuclear RNA and protein play an active role in metabolic processes in non-dividing cells.

Isotopically labeled amino acids are a specialty of Schwarz BioResearch — optically active, carefully purified, tagged with C^{14}, N^{15}, S^{35}, H^3, or O^{18}. We also produce a full line of nucleic acid compounds: DNA, RNA, nucleotides, nucleosides, purines, pyrimidines, sugar and sugar phosphate — plain and radiolabeled. These are all listed in our complete catalog — yours on request.

1. Irritability of the animal fibre. Philosophical Magazine *1*:307 (Aug.) 1798. 2. Rapkine, L.: Sulphydryl groups and enzymic oxido-reduction. Biochem. J. *32*:1729, 1938. 3. Smellie, R. S.; McIndoe, W. M., and Davidson, J. N.: The incorporation of N^{15}, S^{35}, and C^{14} into nucleic acids and proteins of rat liver. Biochem. et Biophys. Acta *11*:559 (August) 1953.

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4 August 1961, Volume 134, Number 3475

SCIENCE

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Chinese Embargo

The newest volume in the AAAS symposium series is *Sciences in Communist China.* The volume and the symposium at the 1960 AAAS meeting at which the 26 papers were originally presented, some in shortened form, involved the cooperation of many people and organizations: a grant from the National Science Foundation, the joint planning of 10 scientific societies with the annual AAAS Conference on Scientific Communication, the scholarship of 30 authors, and the collection from many sources and the distribution to these authors of a quarter of a million pages of Chinese scientific literature of the past decade.

The result is a field-by-field summary that presents both some praiseworthy accomplishments and some failures to achieve the high hopes of Chinese government planners and scientific leaders. The symposium volume, the original literature (which is now on deposit at the Massachusetts Institute of Technology library), and the translations of a number of 10-year reviews written in Communist China by Chinese scholars, each summarizing advances of the past decade in a single field, make available a massive amount of material that hitherto has been scattered and, in the main, available only to persons who could read Chinese.

It is unlikely that there will be another such compilation in the near future, for the Chinese have virtually stopped exporting copies of their scientific journals. Only a trickle has come out since the end of 1959.

The embargo cuts both ways. It will be more difficult for the Western world to learn what is happening in the scientific institutions of Communist China. And it will be harder for Chinese scientists to keep up with Western literature since exchange arrangements have been cut off by the embargo. Clearly this means a loss to scientists in China. It also means some loss to scientists in other countries, and a loss, also, to that abstract entity science itself.

Commenting on the symposium presented in New York, the columnist Holmes Alexander—knowing that he was advocating an unpopular position—recommended continued isolation of Chinese scientists from the rest of the world because "as far down the road as anybody can see, our sworn enemies in Asia would have far more to gain from the exchange than we would." When there is free scientific communication across a border, the less advanced group stands a greater chance of learning something new than does the more advanced group. But the more advanced group has a greater capacity to utilize any new findings gleaned from the other's literature. Which loss is the greater might be debated, but for the moment let us agree with Mr. Alexander that the Chinese have more to gain from a free exchange than we do. Why, then, have they ceased to export their own literature?

A semiofficial explanation is that paper is in short supply and that the number of copies printed does not allow for export, but some skeptics suggest that the real reason is that Chinese science has not advanced as rapidly as their national leaders predicted and that the embargo is to prevent loss of face.

Whatever the reason, the decision was probably politically determined. It is, therefore, not likely to be changed until China learns, as, we hope, the U.S.S.R. and the Western nations have learned, that a nation that attempts to isolate itself from international scientific communication loses more than it gains.—D.W.

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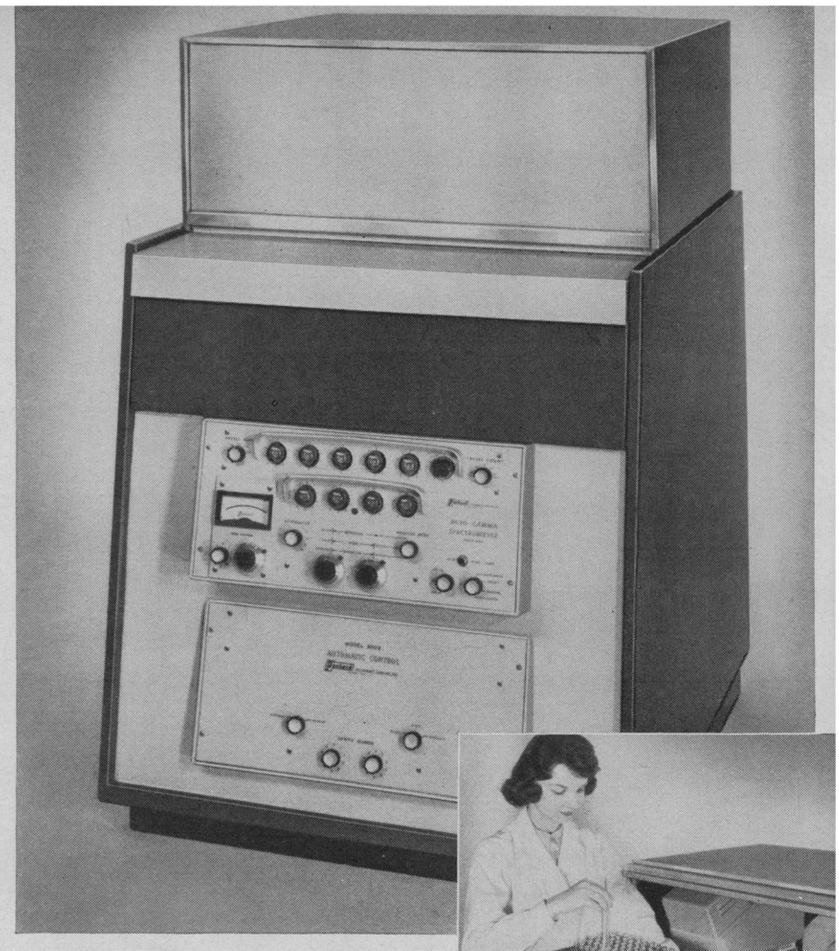

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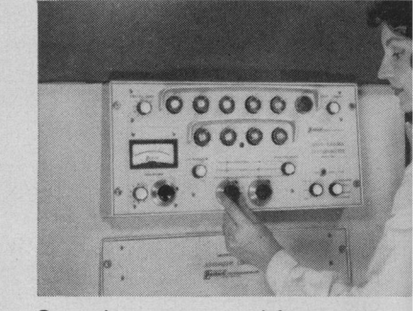
Where work being done does not justify the use of an automatic instrument, the manual AUTO-GAMMA spectrometer is available. It includes the same spectrometer and well-type scintillation detector, and should the need arise it can easily be converted to automatic operation.

For more information call your Packard representative—or write for descriptive literature.



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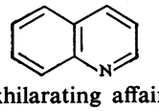
We can remember when we were younger lugging those 22-liter flasks. We distinctly remember that they weighed 76 pounds because we remember weighing one out of curiosity one day. It occurs to us now that we were stronger and luckier than we were smart. A little slip while wrestling that much hot sulfuric acid would have been bad for our complexion. Other ingredients of Skraup brew were aniline, glycerine, and nitrobenzene. The sulfuric acid dehydrates the glycerine to acrolein, the acrolein cyclizes against the benzene ring of the aniline, the sulfuric acid grabs off a third molecule of water, and the nitrobenzene oxidizes off two hydrogen atoms. The chain of events starts quietly enough but picks up considerable exothermic enthusiasm. Result: quinoline,



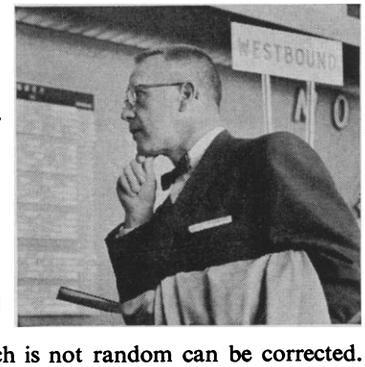
It was an exhilarating affair, particularly when we succeeded in pushing the yield close to 100%. Then we passed 100%, which was even more exhilarating. This we explained by assuming that the nitrobenzene was being reduced to more aniline for participation in the reaction. (Zdenko Hans Skraup would have been justifiably provoked with us for tortuous reasoning. His original proposal was merely to react nitrobenzene, glycerine, and sulfuric acid. Later, aniline was included.)

Anyway, we took pride in the efficiency with which we could furnish the world plenty of good, clean quinoline, a compound once considered the foulest of coal-tar derivatives.

Now it appears that good, clean quinoline is going to be needed more than ever. A new analytical method for determination of phosphorus in fertilizers is based on the discovery that quinolinium phosphomolybdate ($(C_9H_7N)_3$-$H_3PO_4 \cdot 12MoO_3$) is of constant composition, very insoluble, and free of occluded cations.

A free procedural abstract and the quinoline come from Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company). Same address can supply reagents and procedural abstracts to test many things for many ingredients. There is no charge for a list of the abstracts and none for the abstracts themselves, but there is a slight charge for the reagents.

Surviving platemaker



Meet J. Mason Burnham, a brisk-looking Kodak man who has a problem. Mr. Burnham sounds off like this:

"Characteristically, the random shift in position of an image on a Kodak photographic plate is between 0.9 and 1.4 microns. Random, mind you.

"Positional error which is not random can be corrected. The correcting equations can be cranked into the computation program along with all the other computations. A lot of computation has to be done in any event when they measure the missile trail and the star trails on the plates from a whole string of ballistic cameras along a range.

"Randomness is the only ultimate limitation on precision in such a situation. The magnitude of the random component of physical shift of an image on a plate between exposure and measurement is not great in comparison with the magnitude of the errors in all the other quantities that enter into the computation. Small as the random shift is, it is well that we now have a pretty good idea of its size.

"Among transparent materials which can carry an image-bearing emulsion, glass is the only one that has zero humidity expansion coefficient. Of course, its thermal expansion coefficient is less than that of any film base and even less than that of hardened steel. This stability can be handy when you don't have a computer available to remove non-random errors.

"As for flatness, we have recently started accepting special orders for all Kodak plates on ¼-inch micro-flat glass, which means that the surface bearing the emulsion is planar to 0.2 micron per centimeter, for sizes from 4 in. x 4 in. to 12 in. x 12 in."

Mr. Burnham, as noted above, has a problem. The photographic plate was the product with which our founder started his one-man business. Mr. Burnham's problem is to keep this original rootstock of the business thriving despite all the competition for attention that the intervening 81 years have brought. He is going about it through contributions to modern instrumentation. If you would like to ask any questions about Kodak plates for instrumentation—for example, how to process a plate complete to dryness in 10 minutes without much spoiling the spatial stability of the image—write Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y.

Has anybody seen Gwendolyn?

Lucky is the scientific worker who can afford a contemptuous attitude toward office routines. This item will bore him.

It deals with those copying machines that are now seen wherever there is paperwork. Their popularity is traceable to the introduction of the *Kodak Verifax* copier some 8 years ago. Now there are dozens upon dozens of makes of office copiers. The Verifax copier differs from the other inexpensive ones in permitting as many as five copies to be run off from a single sheet of sensitized material. The cost of making n copies is therefore $c_V = s_V + np_V$ where s_V is the cost of the sensitized material (which we call—and don't take this too hard—the "magic matrix") and p_V is the cost of a sheet of copy paper. With the others, the cost of making n copies is simply $c_A = n\ s_A$.

Here are some going rates for Verifax and other systems:

s_V	p_V	s_A	s_B	s_C	s_D
8¢	1¢	8¢	7¢	6¢	5¢

On this basis it becomes clear that if more than one copy is usually required, the Verifax copy is the best buy.

There are copiers which need no expendable sensitized goods. The cost or rental fee for these machines generally confines them to a central location where they can serve an entire organization of some size. This leads to the question of the reason for having a secretary. If you need her merely as a status symbol, we have nothing further to say to you on this subject. If, though, she has more directly useful work to do that justifies a weekly salary of $70 and she averages three 10-minute trips a day to the central copier, her walks for copies cost $225 a year. A Verifax copier could be placed next to her desk for less than $100.

Simple though these great economic truths may be, we have gone so far as to prepare little cardboard calculators for convenience in making representations to the management. Request a free set from Eastman Kodak Company, Business Photo Methods Division, Rochester 4, N. Y.

Price subject to change without notice.

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This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science