

Letters

Biological Research Center

I hope I will not do violence to the logic of John Platt's article on national laboratories for biology [*Science* **136**, 859 (1962)] by putting it in the form of a syllogism, as follows:

I. "... biologists will simply not be able to solve these problems [developing a direct read-out microscope, and so on] successfully unless they begin to form new organizational arrangements" (p. 860).

II. "At present we have no comparable arrangements or organizations [comparable to those in the physical sciences] for systematically exploring and developing new devices and methods for basic biological research" (p. 859).

Conclusion. "... it may be that the only way to achieve [rapid development of new tools for biology] will be to take a leaf from the physical scientists' book and establish a permanent national biological research and development center, a kind of small-scale Los Alamos for biology" (p. 860).

Apart from the fact that Los Alamos will seem to many scientists a poor choice for a model of the laboratory of the future, I think that when the argument is stated in this form it is immediately obvious that the conclusion does not necessarily follow from the two premises. With equal logic (or lack thereof) one might state that we need to take a leaf from European experience with CERN (the European Organization for Nuclear Research) and establish a supranational biological research center. Or to move in another direction, perhaps such a laboratory should have an urban-regional basis. For instance, the scientific and engineering firms of the San Francisco Bay area, in cooperation with other industries and with educational institutions, might pool their resources to establish and support such a biological research center. The federal government might aid such developments through tax relief to cooperating corporations.

From a strictly logical viewpoint Platt's conclusion is qualified properly by the phrase, "it may be that the only way"; however, nowhere in his article does he explore the possibility that establishment of a national research center may *not* be the only way. I would merely like to suggest that anyone seriously considering the problem situation so excellently stated by Platt should examine several alternative methods of dealing with that problem.

JOHN MARTINSON

2214 Russell Street,
Berkeley, California

On the Moon Illusion

I read with great interest the articles by Rock and Kaufman on the moon illusion [*Science* **136**, 953, 1023 (1962)]. Their proof that the visible terrain between the observer and the horizon contributes to the moon illusion is an important finding and is based on ingenious experiments. I cannot, however, agree with the authors when they imply that the presence of terrain provides the sole cause of the illusion. I do not think that their method of measuring the illusion with the help of two artificial moons at optical infinity yields the full illusion. They obtained average illusion ratios below 1.5, whereas an earlier investigator, Pozdena, who had his subjects match an artificial moon at a distance of 4 meters to the zenith and the horizon moon, obtained the much larger average illusion ratio of 2.5. I strongly suspect that additional factors enter into the ordinary moon illusion.

One of these is the angle-of-regard illusion, which was most thoroughly investigated by Holway and Boring. It consists in a strong reduction in apparent size when the moon is viewed with eyes raised or lowered relative to the head. Holway and Boring measured this illusion by matching the apparent moon size with a luminous disk at a

distance of 3.5 meters. Rock and Kaufman, however, found no effect of eye elevation on apparent moon size and therefore suspect Holway and Boring's results. But there is no necessary contradiction: Rock and Kaufman used a different technique, employing an artificial moon at optical infinity as comparison object instead of a luminous disk at near distance. In this context, they claim that only their technique is adequate and has a bearing on the ordinary moon illusion.

To me the difference in the outcome of the two experiments makes sense. As Rock and Kaufman explain, perceived size is a function of registered distance; with the size of the retinal image constant, the larger the distance the larger the perceived size. Registered distance depends on two kinds of cues, convergence of the eyes and configurational cues when patterned surfaces extending toward the object are visible. Being caused by eye position, the angle-of-regard illusion clearly must be a matter of convergence and thus should occur only when the distance of at least one of the two objects to be compared is within the effective range of convergence. Since this is not the case in Rock and Kaufman's experiments, it is not surprising that they did not obtain the angle-of-regard illusion.

I turn now to their claim that Holway and Boring's way of testing the moon illusion, by matching an object at close distance to the apparent moon size, is inadequate. They point out that the apparent size of an object at infinite distance is to a high degree undetermined because no adequate cues for distance are available, and that therefore the comparison object ought to be at infinity also. I do not agree. I prefer the procedure used by Holway and Boring and by Pozdena. If a comparison is to tell me something about the perceived size of an object, I prefer to have as comparison object one whose perceived size is accurately determined by distance cues and therefore definite and not spontaneously variable.

Rock and Kaufman also claim that their method of comparing two moons at optical infinity is more in keeping with the ordinary moon illusion. They overlook here, I think, the work of Schur, who showed that the moon illusion by no means pertains only to objects at infinity. Experimenting in dark rooms of various sizes, Schur demonstrated a strong size-elevation illusion which ties the moon illusion to size perception at medium distances.

Working with two projected disks of light, one in horizontal direction and the other above the observer and at the same distance from him, Schur found a size difference in favor of the horizontal disk which increased steadily with increasing distance of the two disks from the observer. The distances were varied in six steps from 3 to 33 meters. For the distance of 3 meters the mean illusion ratio amounted to 1.16, and at distances of 22 and 33

meters, to 1.71 and 1.87. Today these findings are supported by the result of Hermans' whose illusion ratio of 1.06 for distances of 4 feet fits well with Schur's data (and does not refute them, as Rock and Kaufman claim), and by the results of Leibowitz and Hartman; only Rock and Kaufman's planetarium experiment is in disagreement.

I see Schur's size-elevation illusion as a thing apart from the terrain effect. Rock and Kaufman surmise that there

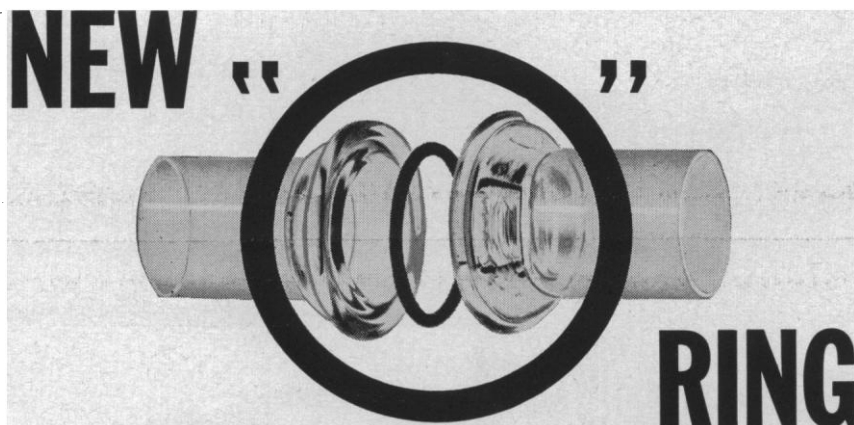
was enough stray light in the rooms used by Schur to illuminate the floors. I don't think that this explanation is tenable. Schur's report shows that a great deal of attention was paid to the task of keeping walls and floors invisible; the projectors were completely enclosed, and the subjects were not allowed to become dark-adapted. Besides, if Schur's results were really due to a vestige of a terrain effect, one would expect her illusion ratios to be smaller than those obtained by Rock and Kaufman with good terrain visibility. The opposite is the case; for the 33-meter distance Schur's illusion ratios show an effect almost twice as large, and with much less variability. Since Schur also found her effects to be partly independent of the angle-of-regard illusion—she did obtain an angle-of-regard effect with disks of light at distances of 5.2 meters which, when set against the ordinary size-elevation effect, would diminish but not overcome it—it looks as if we have here a third condition which can produce a moon illusion.

I want only to set the record straight, not to advocate more discussion or research on the ordinary moon illusion. As is the case with many phenomena of our daily lives, its causes are probably too complex to warrant detailed unraveling. But I don't like to see the angle-of-regard illusion and the size-elevation illusion neglected as unimportant. These facts are of genuine scientific interest, having relevance to perception independent of the moon illusion.

HANS WALLACH

Department of Psychology and Education, Swarthmore College, Swarthmore, Pennsylvania

Kaufman and Rock's thorough investigation of the dependence of the moon illusion on the presence or absence of a visible, uninverted, intervening terrain makes important reading and seems to me, the surviving member of the Holway and Boring team and Kaufman and Rock's most clearly defined target, to lend strong support to Ptolemy's theory and the effectiveness of Emmert's law in this situation. It can be said, of course, that Ptolemy's theory is Emmert's law, and that everyone knows that Emmert's law works. Emmert's law is the principle that the size of a perceived object increases with its perceived distance in those unusual cases, such as a visual afterimage, when the size of the retinal image remains



CONNECTOR SIZES FOR VACUUM APPARATUS

THREE NEW SIZES, the 50 mm, 75 mm, and 100 mm I.D. connectors, are the latest additions to an extensive list of Kontes "O" Ring Connectors in glass, stainless steel, and brass.

VACUUM APPARATUS made with Kontes "O" Ring Connectors requires minimum displacement to assemble, avoids lubricants, and holds vacuums of 10^{-6} mm of Hg.

LUBRICANT FREE connections are obtained because the hemispherical connector arms are separated, but sealed by a Buna-N or Viton® "O" Ring*—not by a grease. This avoids sticking and freezing problems associated with ground glass joints.

METAL TO GLASS coupling is a simple matter now using a standard glass connector and a standard brass or stainless steel connector. Compared to graded metal and glass seals, the ruggedness and flexibility of such connections are particularly impressive.

*Optional Viton "O" rings, which are recommended for service with steam, silicone greases, and oils, are also resistant to oxygen and ozone. The temperature limit using Buna-N is 150°C.—with Viton 300°C. intermittently, 200°C. continuously. ©Viton is a registered trademark of E. I. duPont Co.

For more complete information request Bulletin 1161-A.

Size & Approx. I.D., mm	K-67175 Glass		Size & Approx. I.D., mm	K-67175 Glass	
	Per Pair	Single Arm		Per Pair	Single Arm
5	2.70	1.35	25	3.10	1.55
7	2.80	1.40	30	4.20	2.10
9	2.80	1.40	40	6.00	3.00
12	2.90	1.45	50	7.50	3.75
15	2.90	1.45	75	10.00	5.00
20	3.10	1.55	100†	14.00	7.00

†Shaped like Conical Pipe Flange.



KONTES GLASS COMPANY
Vineland, New Jersey

Midwest Distributor: **RESEARCH APPARATUS, INC.**

9943 West Franklin Avenue, Franklin Park, Illinois

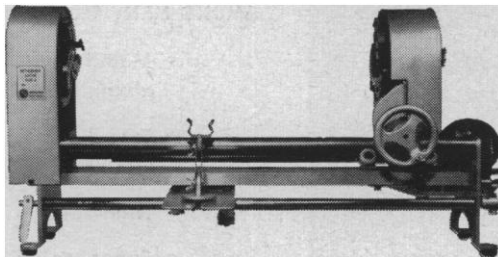
ALL NEW
LOW
PRICE

GL50 A BENCH GLASS LATHE

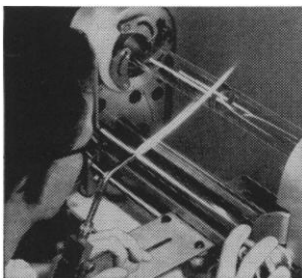
for professional or occasional glassworking

This unit is durable and compact requiring only 2' x 3' bench area . . . can hold tubing from 0-64 mm through spindle and up to 6" o.d. on the exclusive contour chucks. Complete, ready to operate.

Price \$675.00

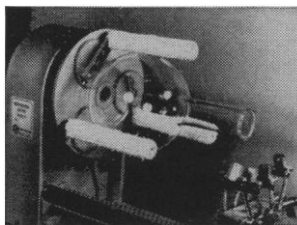


IDEAL FOR PHYSICAL, CHEMICAL, BIOLOGICAL AND ELECTRONIC LABORATORIES



With NEW CONTOUR CHUCKS, two independently working sets of slim self-centered jaws permit, for the first time, chucking and centering of a variety of shapes and sizes.

GL50 B FLASK HOLDER with asbestos covered Steel Fingers. Universal, self-centering; permits mounting in head or tailstock up to 6" o.d.; accepts blowhose and swivel. BURNER CARRIAGE holds lathe fire or one or two hand torches.



ASK YOUR DEALER FOR DETAILS.

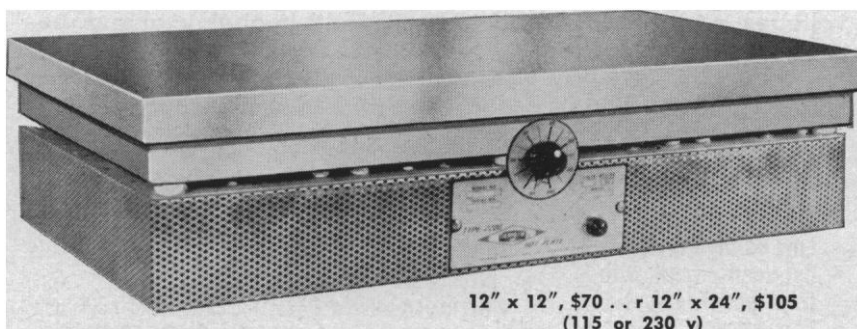


BETHLEHEM APPARATUS COMPANY, INC.

HELLERTOWN, PA.

new design

improves performance,
reduces price



12" x 12", \$70 . . . 12" x 24", \$105
(115 or 230 v)

THERMOLYNE

TYPE 2200 HOT PLATES

offer precision thermostatic control
and fast heat-up over the
entire stepless range to 700° F

Write for literature and name of nearest dealer

THERMOLYNE CORPORATION, 568 Huff St., Dubuque, Iowa
(Formerly Thermo Electric Mfg. Co.)

constant as actual distance varies. If visually filled distance looks greater than empty distance, then the horizon moon, separated from the observer by a filling of terrain, should look further off and, subtending always the same visual angle, should appear larger. The difficulty here is that the preponderance of evidence, against which Kaufman and Rock cannot do better than set up their fiat, is that the horizon moon looks nearer than the moon in elevation. Of course, say the subjects, it looks nearer because it looks bigger, and that leaves us with a paradox.

Neither Holway and I nor Kaufman and Rock made any well-designed study of the perceived distances of the moon, although Holway and I did ask questions about perceived distance of a good many observers. If one is studying the effect of apparent distance on apparent size, one would do well to measure the relative apparent distances as well as the relative apparent sizes, would one not?

Kaufman and Rock say that the size of the elevated moon is indeterminate. Now surely that is nonsense. All size is relativistic, and, when not under comparison, size is necessarily indeterminate. You spend an hour watching a puppet show on a lighted stage surrounded by the dark, the curtain falls, the general lights go on, and the actors themselves who make the little figures work appear to take their bow. A gasp of astonishment goes through the audience when these apparent giants appear. Actually, the puppets lost apparent size when they lost their standard of comparison. No perceived object has determinate size except as its size is fixed in a comparison.

Then Kaufman and Rock object to the fact that Holway and I used heterotelic comparisons of size (*heterotelic* is from *tele*, afar, as in *telescope*, not from *telos*, end, as in *teleology*). Abstractive comparisons, such as the heterochromatic equating of visual brightnesses, are more difficult to make than judgments of identity, but they are not invalid. The measure of difficulty lies in the large size of the interval of uncertainty about the point of subjective equality and in the longer decision times for the more uncertain judgments. Given a difference somewhat larger than the interval of uncertainty, be that interval large or small, the judgment is immediate. Holway and I found, for our extreme heterotelic comparisons, that the judgments were certain and instant. Conversely, even identity judgments near the critical point are slow

YOU'RE NEVER IN DOUBT WHEN IT'S "Alconox- Clean!"

In the laboratory or hospital, just "clean" isn't good enough. Make sure your glassware and equipment are "Alconox-Clean."

- Proven best by test* for over 20 years!
- * for wetting power!
 - * for sequestering power!
 - * for emulsifying effect!

Use ALCONOX
For all equipment washed by hand
Box of 3 lbs. \$1.95
Case of 12 boxes —
3 lb. ea. ... \$18.00
Available in drums of 25, 50, 100 and 300 lbs. at additional savings!
(Prices slightly higher West of the Rockies)



**SAVE TIME
AND MONEY!**
with **ALCONOX**

The World's Most Thorough Cleaner —
Yet it costs up to 75% less!

Eliminates tedious scrubbing —
Penetrates irregular and inaccessible surfaces — Removes dirt, grease, grit, blood, tissue, etc. with amazing ease — Completely soluble and rinsable — Gentle to the skin —



Use ALCOJET
For all equipment washed by machine
Box 5 lbs. \$3.00
Case of 6 boxes —
5 lbs. ea. ... \$15.00
Available in drums of 25, 50, 100 and 300 lbs. at additional savings!
(Prices slightly higher West of the Rockies)
Clean Pipettes in one easy operation with ALCOTABS — for all pipette washers. Box of 100 Tablets. \$5.00

Order from your Supplier or ask him for samples and FREE Cleaning Guide.

ALCONOX, Inc.
853 Broadway, New York 3, N. Y.

and unsure. There is nothing wrong with the heterotelic method except that it is less precise than homotelic comparisons of size, or, one might say, the heterotelic method is as accurate as the homotelic but in respect of larger units.

Now let us raise the question as to how much we must stretch credulity to believe that Emmert's law, set up by the filled distance of the terrain, can account for the moon illusion. I have read Wallach's letter about these researches with assent. He notes that there is probably no single correct theory of the moon illusion, and even Kaufman and Rock admit in a note that more than one principle may be operating synchronously. Emmert's law is consistent with the principle of size constancy: that the receding object maintains the same apparent size as its retinal image shrinks, and thus that a receding object whose retinal image does not shrink (an after image) grows in apparent size. Another law, incompatible with this one, might be called Euclid's: a receding object appears to shrink in size as its retinal image shrinks; and conversely, *mutatis mutandis*. The observers in the Holway and Boring studies were appealing to Euclid's principle when they said that the horizon moon looked near because it looked so large. Certainly this principle often works, and then, of course, size constancy fails.

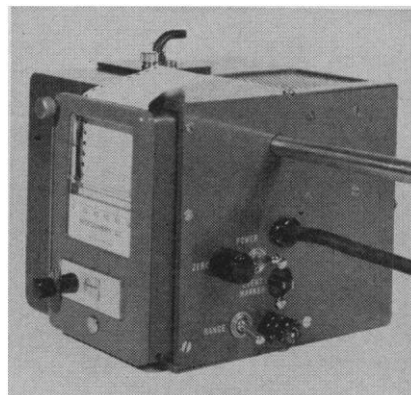
Now, Kaufman and Rock are arguing that these two principles operate simultaneously, each of them effectively, though in opposite directions. They adopt Woodworth and Schlosberg's word *register*, which means that a perceptual cue operates below the level of consciousness. A distance may be great as registered while being small as perceived. Let me extend this argument and suggest its treachery by being explicit. The visible terrain is effective as a cue. It operates below the level of consciousness to register the moon as far away. Under Emmert's law the moon is thus, because of its remote registry, perceived as large. Looking large, it seems, under Euclid's principle, near. And might one not then add that, under Emmert's law appearing near, it looks small? That would be the whole circle of logic of these two principles: the horizon moon, being far, is big; being big, is near; being near, is small. Obviously, still more research and more thinking are needed on this matter.

Kaufman and Rock could have aided their readers by being more precise in

MINI-MONITOR

THE ECONOMY TOOL

FOR
ULTRA-VIOLET ANALYSIS
OF COLUMN EFFLUENT



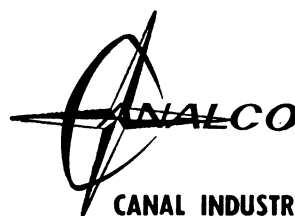
A great new labor-saver!

Watches and records UV absorption of column effluent before the fraction collector, producing absorption peaks on a strip chart to tell you which fraction tubes contain material of interest.

Entire instrument, including recorder, is self-contained in one cabinet only 7" cubed and weighing only 10 pounds. Mounts directly on the stand of any fraction collector. %T recording; 254 mu peak radiation; event marker to record fraction changes; range expander for sensitivity adjustment. For use with proteins, nucleic acids, or other materials having reasonable absorption at 254 mu.

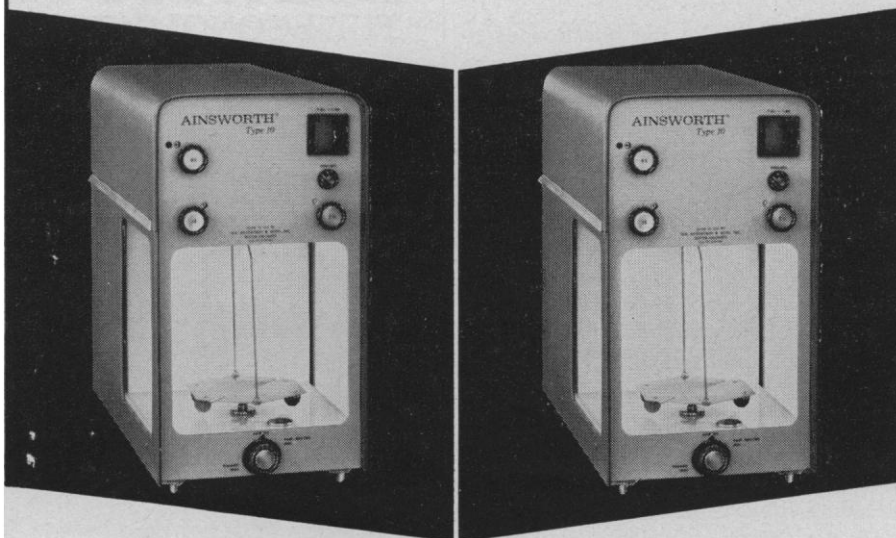
**ORDER NOW FOR
IMMEDIATE
DELIVERY ... ONLY \$790**

f.o.b. Bethesda, Md.



CANAL INDUSTRIAL CORP.
Dept. E-93 4935 Cordell Avenue
Bethesda 14, Maryland

THESE ARE TWO IDENTICAL
AINSWORTH BALANCES...



ONE IS A BETTER BUY!

Because it's in stock at your nearby Will warehouse—like almost every Will item.

Better yet, you're protected by Will's exclusive *double guarantee*—the manufacturer's warranty backed up by an unconditional guarantee of satisfaction by Will.

And there's service. At Will, you're always welcome back to use the industry's finest service facilities—for routine maintenance, emergencies, or major overhaul.

Will gives you the greatest selection of brands and items to choose from—your Will representative has a complete technical reference file on practically every one of them.

We think you'll make a better buy at Will—why not find out.

NEW, COMPACT SINGLE PAN BALANCE BY AINSWORTH

Features a taring device unique among substitution balances. Two small trays under the pan hold discs having total weight of 60 grams. Weight of container easily cancelled out by removing discs.

Compact design, easily accessible weighing chamber, 100 mg optical range, 160-gram weighing capacity, plus taring up to 60 grams.

Patented compensated beam minimizes effects of changes in temperature, air density and humidity.

Semi-micro type 12 model also available—100 mg range, 80-gram weighing capacity, plus up to 40-gram taring.

Write for technical literature or free demonstration.



Scientific, Inc.
and subsidiaries

Rochester 3, N. Y. • Baltimore 24, Md. • New York 52, N. Y.
Atlanta 25, Ga. • Buffalo 5, N. Y. • So. Charleston 9, W. Va.

their terminology. Again and again they speak of "the greater apparent distance" of the horizon moon. Only occasionally do they use the word *register*, introducing it in connection with a half-hearted admission that the apparent distance to the horizon moon may be small although the registered distance is great. They speak of "phenomenal size" and seem to mean by that term the consciously apparent distance. They speak occasionally of "report" as if it could be expected to contradict the character of the phenomenon reported upon. The situation described and the theory based upon it need careful explication, and it would help were these five words defined and used with rigor: *apparent*, *perceived*, *registered*, *phenomenal*, and *reported*. Then the paradox outlined earlier would become clear—or so I think.

EDWIN G. BORING

*Psychological Laboratories,
Harvard University,
Cambridge, Massachusetts*

Wallach and Boring make a number of interesting points concerning our work on the moon illusion. On the whole they raise different arguments, except for one on which they agree. They both defend the method used by Boring and his colleagues (and Pozdena) to measure the moon illusion (in fact, Wallach believes it preferable to the method we have developed). We still disagree. The disk projected on the nearby screen in Boring's method appears to be of a definite linear size. But the moon does not; we believe it is correct to say that the moon is indeterminate as far as an impression of linear size is concerned. How, therefore, can we rely on a comparison object which appears to be of a definite linear size to tell us about the apparent size of the moon? Wallach implies that such a comparison is desirable because at least the size of the comparison object is stable and definite. How, then, does he explain the fact reported by Boring that, if the observer backs away from the screen, the disk he has just selected no longer appears to match the moon? Obviously the moon's size would not be affected by these few additional feet and the disk's size would not change, because size constancy would obtain. Apparently the observer is, at least in part, comparing the moon and the disk in terms of their visual angles. Where is the stability of the comparison object Wallach hints at? (It is surprising

to find Wallach arguing for Boring's method when he has recently published a paper, with McKenna, the main conclusion of which is that comparison of an indeterminate object at an indeterminate distance with a determinate object at a determinate distance is essentially not possible!)

Boring's statement that all size is necessarily relativistic obscures the important difference between determinate and indeterminate linear size. An apple at some definite distance has determinate size, whether or not one is comparing it to anything. Of course, by "determinate size" we mean a size that has meaning in the whole scale of sizes in our world (for example, smaller than the hand but bigger than a grape), and this is no doubt what Boring means by "relative." But the size of the moon, particularly when it is at the zenith, is none of these. One cannot rank it anywhere on the scale of linear sizes we deal with. It is not even necessarily very large, linearly speaking. Unlike the apple, it is indeterminate, and for a very good reason. Its distance is more or less indeterminate. That it is indeterminate is an empirical fact. Subjects cannot decide or agree on its linear size. Of course, the moon does have a size relative to other astronomical objects—for example, to the distance between two stars, or to itself in other positions. But this is not a matter of relative linear size. Our method is based on such a nonlinear comparison.

Wallach seems to forget that our focus was the moon illusion as it exists in daily life. Are we to believe that that illusion requires comparison of the moon with some nearby object and that it is the cross-comparison with that object that mediates the moon illusion? That is, are we to believe that the illusion is based on the observer's first comparing, say, the zenith moon with some nearby object and, on some other occasion, comparing the horizon moon with that object? When we say the horizon moon seems large to us, don't we mean large in comparison to the size we remember the zenith moon to be? That is why we strove to use a method wherein the observer could compare one moon with the other, as he does in daily life. Even if such a comparison is not reliable for the reason Wallach suggests (although we don't agree that this is the case), the plain fact is that that comparison is the moon illusion. Boring himself said in 1943 that the illusion "is a comparison of the moon with itself seen previously."

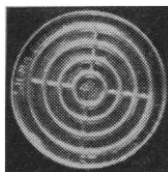


PLANCHETS!

We don't know why we got involved in this, but, oh well! Someone asked us for PLANCHETS, so we made PLANCHETS! It just proves again that "It IS a pleasure doing Business with Sigma!"

Of course we couldn't make planchets only as good as others make them. Our's had to be better, so we are pleased to offer—

PLANCHETS



Size—1.25" Diam. x 3/32" Deep (32 mm x 2.5 mm)

Stainless Steel
Stock No. 316-1

100 Planchets	—	\$ 5.15
500 Planchets	—	21.00
1000 Planchets	—	35.00
5000 Planchets	—	160.00

Aluminum
Stock No. AL-1

100 Planchets	—	\$ 3.75
500 Planchets	—	11.80
1000 Planchets	—	18.00
5000 Planchets	—	81.00

cif destination—Postage Paid anywhere

Note our new design—not only several concentric rings, but four quadrants to provide even better distribution over maximum area—no accumulation of all the solids down in one crevice. The aluminum planchet is probably good enough for many purposes where economy is important.

At present we only have one size—because we were only asked for one size. Eventually we probably will be asked for other sizes, so I guess we will make other sizes too! (It is all in a day's work at Sigma!)

Incidentally we still make pretty good chemicals, too. For example several groups around the world have been probing into red cells to measure the Glucose-6-Phosphate Dehydrogenase there. It is probably safe to say that almost all of them depend upon Sigma for the TPN and Glucose-6-Phosphate substrates needed. Then it came to our attention that much of this work was being done in the Tropics because many Negro groups are particularly deficient in this enzyme. Since TPN and G-6-P required deep-freeze storage, work was stymied. Sigma came to the rescue and developed the Berger Procedure No. 400 for

Red Cell

GLUCOSE-6-PHOSPHATE DEHYDROGENASE

All the sensitive reagents are in a dry vial precisely measured for either one single determination or multiple determinations. They are stable even in the Tropics without any refrigeration and the scientist doesn't even need a balance to measure ingredients or a spectrophotometer to measure O.D. When red cell hemolysate is added he gets an almost black solution. With "normal" cells, it will turn red in about thirty minutes; with deficient cells it might take several days to turn red. Now I understand everyone is happy—both here at Sigma and down in New Guinea.

In case you are wondering why anyone would want to study G-6-P Dehydrogenase, please see the references below. It seems that some people get born without their share of it and they might be heading for trouble unless we learn more about it. About 10% of the children in Sardinia who have this deficiency will die if they eat fava beans which seem to be harmless to others. Many people are afflicted with Hemolytic Anemia following certain therapy, exposure to naphthalene, etc., and it might be well for the physician to consider G-6-P Dehydrogenase deficiency. About 25% of the American Negroes are deficient. Much more research is needed to learn all the ramifications of this enzyme, and Sigma is the only reputable U.S. producer of the vital reagents needed to facilitate this work.

References:

- 1) Tarlov, et al., "Primaquine Sensitivity", Arch. Int. Med., 109, 209, (1962).
- 2) Marks, et al., "Erythrocytic Glucose-6-Phosphate Dehydrogenase of Normal and Mutant Subjects", J.B.C., 236, No. 1, (1961).
- 3) Kellermeyer, et al., "Hemolytic Effects of Therapeutic Drugs", J. Am. Med. Assoc., 180, 388, (1962).

P.S. If you like these discourses, let us know and we will try to find time to write some more of them. Life at Sigma is sure exciting, and we love to tell people about it. Anyone looking for a job?

CALL US COLLECT TO PLACE ORDERS OR DISCUSS PROBLEMS ANYTIME

Day, Station to Station,
PRospect 1-5750

Night, Person to Person,
Dan Broida, WYdown 3-6418



The Research Laboratories of

SIGMA CHEMICAL COMPANY

3500 DE KALB ST. • ST. LOUIS 18, MO. • U.S.A.

MANUFACTURERS OF THE FINEST BIOCHEMICALS AVAILABLE

Wallach's defense of the eye-elevation hypothesis is that eye elevation affects convergence and convergence could not influence the illusion unless "the distance of at least one of the two objects to be compared is within the effective range of convergence." Hence, a method such as Boring's is required to produce the effect. Our question, again, is: Does the illusion in daily life require mediation by way of some nearby comparison object? If so, no one seems to be aware of it. Hence, if Wallach's reasoning is correct, eye elevation could not possibly explain the moon illusion, although it could explain Boring's findings. However, a point we made in our paper is worth repeating—namely, that in spite of the quantitative results based on eye elevation, the observers in the Holway and Boring studies were im-

pressed with the large size of the (geographical) horizon moon and the smaller size of the (geographical) zenith moon.

The supine observer says the zenith moon "does not appear large to him, yet he equated it to an artificial moon to which, when erect, he had already equated the horizon moon." As Patrick Rizzo recently pointed out in the bulletin of the Amateur Astronomer's Association, the moon illusion is a "seeming," an impression of size. Boring's subjects reported this impression while giving quantitative data of a different kind. In such a case of contradiction it is the method employed that must be questioned. One final point about Wallach's argument: we do not understand why convergence with respect to the nearby *comparison* object is required

before eye elevation in viewing the zenith moon can emerge as a cause. The convergence is the same for the comparison object whether the standard is the horizon or the zenith moon. Does Wallach mean to suggest that what is crucial is the *transition* from eyes level to convergence on a nearby object or from eyes elevated to convergence on a nearby object? What evidence is there for such an effect, and what is its rationale? Suppose the observer rests his eyes a moment after looking at the moon before focusing on the comparison object. Would Wallach now predict no moon illusion?

There is another curious fact. Both Wallach and Boring seem to admit that our evidence for the role of the terrain is convincing (although this hypothesis had been discarded ever since Boring's research was published 20 years ago). If apparent or registered distance does affect the illusion as strongly as our evidence shows, and if Boring's method is indeed a good one, why is it that his data show no influence of the terrain? For example, Holway and Boring obtained an illusion ratio of 1.0 when observers viewed a horizon moon normally and a zenith moon with head elevated and eyes level.

We turn now to a second point. Boring still seems reluctant to subscribe to the apparent-distance hypothesis (in spite of his opening sentence) because of what he calls "the preponderance of evidence . . . that the horizon moon looks *nearer* than the moon in elevation." The preponderance of evidence to which he refers is presumably the reports of observers that, of the two, the horizon moon is *nearer*. We will not repeat here all our reasons for not being greatly concerned with this report. We thought we had done more "than set up a fiat" when we suggested that such reports were probably based on judgmental reactions to the difference in *phenomenal* sizes of the two moons (which difference *is* the moon illusion) and when we backed up this suggestion by two experiments. One showed that subjects do use the apparent relative size of the moon as a basis for answering the question, Which moon seems nearer? The other showed that, with moons absent, observers do report the horizon sky to be farther away than the zenith sky.

Boring tries to reduce our argument to an absurdity by the following deduction: if the horizon moon is indeed judged nearer because it seems larger, it now ought to seem smaller because

NOW . . . TWO MODELS . . . TWO CAPACITIES . . . FITS EVERY NEED !



THE POPULAR CENT-O-GRAM

Unbeatable for general laboratory weighings, specific gravity work, and pre weighing.

Portable . . . Adaptable for use in many fields.

CAPACITY 311 GRAM
SENSITIVITY .01 GRAM

THE ALL NEW DEC-O-GRAM

This latest OHAUS overhead triple beam balance features 2610 gram capacity, sturdy box end beam, sliding type poise with center indicating panel, self aligning bearings, self storing attachment weights, and specific gravity platform.

Available in:
Model 3600 (Metric)
Model 3601 (Avoir.)

CAPACITY 2610 GRAM
SENSITIVITY .05 GRAM

OHAUS

write for complete information

OHAUS SCALE CORPORATION
1050 COMMERCE AVENUE UNION, NEW JERSEY

LEA & FEBIGER BOOKS

An Intro. to the Study of Disease

By WILLIAM BOYD, M.D., University of Toronto, Canada; and University of Alabama, Birmingham. 478 pages. 174 illustrations and 4 plates in color. New 5th (1962) edition. \$7.50

Dr. Boyd presents a clear understanding of the nature and cause of disease. The reader need have no background in anatomy, physiology or bacteriology. Previously titled "An Introduction to Medical Science," the new title better describes the book's purpose and content. The text has been so fully revised that it is virtually a new book.

Pharmacognosy

By EDWARD P. CLAUSS, Ph.D., Ferris Institute School of Pharmacy, Big Rapids, Michigan. 565 pages, 7" x 10". 227 illustrations and 1 plate in color. New 4th edition. \$12.50

Botanical characteristics and chemical constituents of drugs, and therapeutic agents and commercial products derived from the plant and animal kingdoms are presented clearly in this book. The biochemical classification of drugs is employed throughout. Conforms to the U.S.P. XVI and N.F. XI.

Principles of Human Physiology

Edited by HUGH DAVSON, D.Sc., and M. GRACE EGGLETON, D.Sc., M.R.C.S., University College, London. Foreword by SIR CHARLES LOVATT EVANS. 1579 pages. 851 illustrations and 9 plates. New 13th (1962) edition. \$16.00

Features include Wilke on Muscle, Rush-ton on Nerves, Whitteridge on Central Nervous System, Davson on Special Senses and Physiology of Sensation, Daly on Circulation and Respiration, Smyth on Biochemistry and Physiology of Digestion and Nutrition, Eggleton on the Kidney, Lewis on Temperature and Heat Balance, Harkness on Reproduction and Endocrines, and Datta on Blood.

LEA & FEBIGER

Washington Square
Philadelphia 6, Pa.

Please send me books circled above or listed in margin below.

I will return books or pay for those I keep within 60 days of their receipt.

NAME

ADDRESS

CITY ZONE ... STATE
Sc. 9-14-62

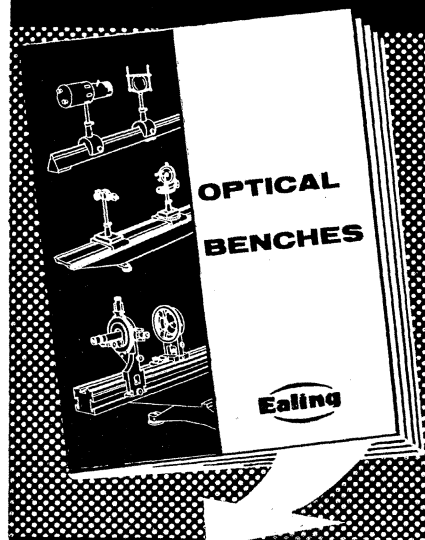
it is judged nearer. We would answer that a judgment of this kind (which in this case is perhaps only elicited by a question) does not influence perceived size. A judgment or inference is not to be equated with a sensory cue to distance. Perception is rarely if ever influenced by knowledge about the situation—if it were there would be no moon illusion.

Wallach believes we have not obtained the full moon illusion, citing earlier work by Pozdena in which an illusion ratio of 2.5 was obtained. This argument has little force when the method used by Pozdena (being like that of Boring) is itself in question. We wonder, however, what Wallach's explanation is for the fact that Boring and his colleagues did not obtain an illusion of that magnitude with the same method. Their illusion was closer to the values we obtained.

Finally we come to Wallach's reference to the earlier experiments of Schur in dark rooms of various sizes, and to the recent work of Hermans and of Liebowitz and Hartman. Common to all these experiments is the finding of an illusion when equidistant horizon and zenith objects are compared in a dark field at a finite distance. First, we would point out that this method is different from that of Boring's. It is in fact similar to ours in that both objects are now at the same distance. To the extent that distance perception is diminished in the dark, the method is even closer to ours. Hence, Wallach has shifted his position insofar as preferred methodology is concerned (for example, convergence could have little effect if both objects are at 33 meters). Second, the question arises as to why the effect increases with distance (it is quite small at 3 meters, for example) if convergence is what is crucial. Boring answered this question long ago by saying the moon illusion is greatest when distance is indeterminate. Third, if the previous point is correct, is not the ideal experiment one in which distance increases to a maximum? (Extrapolation from Schur's curves leads to this prediction, and Hermans made the same prediction.) In that case, our indoor experiment in a dark field with the two disks at optical infinity is ideal. Yet we obtained only a negligible effect. Our planetarium dark-field experiment yielded a similar result.

This leaves us with the problem of explaining Schur's results and those of Liebowitz and Hartman. Perhaps Wallach is right in stating that our specu-

A NEW Catalog



Introduction page

"This, we believe, is the most comprehensive range of Optical Benches and Accessories offered.

There are five basic benches for different applications with varying accuracies, each with its appropriate carriers. There are sixty different accessories.

This range meets every requirement from simple alignment to the precise investigation of any optical system.

A unique feature of this range of Optical Benches is its flexibility.

The first three benches all take accessories mounted on 13.5 mm. stems and therefore all 40 accessories listed — can be used interchangeably on these three benches.

The last three benches take the research accessories listed.

The middle bench, that is the Precision Lathe Bed Optical Bench — has the special advantage of taking both the standard accessories — and the research accessories listed."

WANT TO READ FURTHER?
This Catalog is FREE
on request from

THE **Ealing** CORPORATION

33 University Road,
Cambridge 38, Massachusetts
Telephone: 617 Kirkland 7-5760

lation that they are based on stray light is not tenable. A more promising lead is a recent finding of Gruber, King, and Link to the effect that an illusion indoors depends on the observer's first gaining some impression of the distances involved in the room prior to the darkening of the room—on a kind of memory effect which may itself be a function of (remembered) apparent distance.

We agree with Boring that there is a tendency toward imprecision in our use of certain terms. We believe this is largely due to the fact that we sought to derive the moon illusion from certain already known facts and principles in the area of size perception. Unfortunately, that area is itself still beset with theoretical difficulties.

IRVIN ROCK

*Department of Experimental and
Clinical Psychology,
Graduate School of Education,
Yeshiva University, New York*

LLOYD KAUFMAN

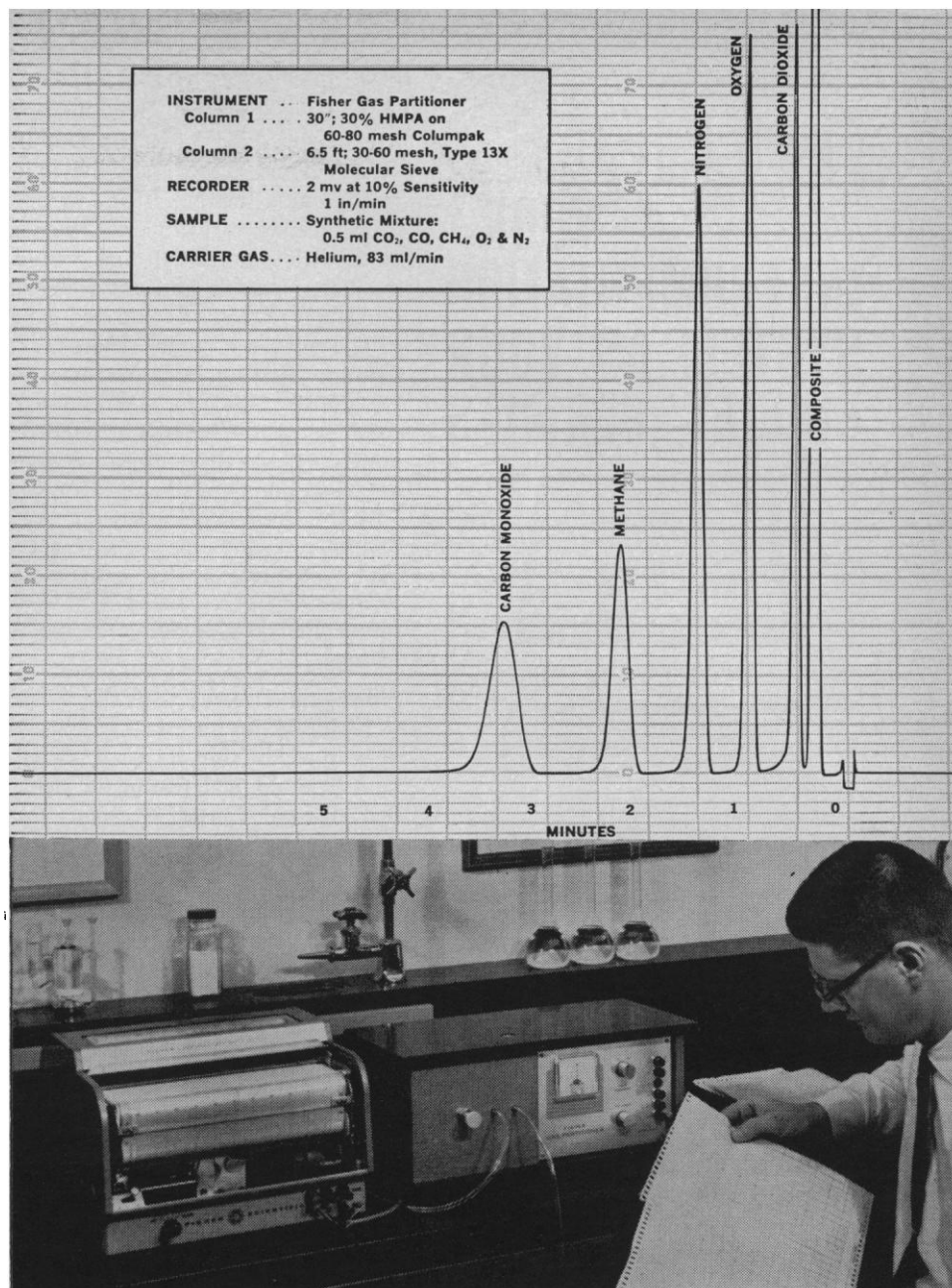
*Sperry Gyroscope Company,
Great Neck, New York*

Battle Not Won

The item entitled, "Congress shrugs at proposals on laboratory animal welfare" [*Science* 126, 863 (1962)], could easily give the impression that all is well and that those interested in animal research have little cause for concern.

It is true that Congress will not have time in the few remaining weeks of this session to consider proposals to regulate research and teaching involving the use of animals. It probably is true also that most members of Congress do not at this time favor such legislation. Further, it is true that there are only about 6 million antivivisectionists in the United States—a small minority of the population.

But this is where the good news ends. Members of Congress report that mail on the Moulder, Griffiths, and Clark bills is running approximately 20 to 1 in favor of regulation. Experience in legislative bodies around the nation shows that politicians will, in the end, do what they believe the voters want, regardless of their own convictions. Experience further shows that a tiny minority of antivivisectionists can, by writing letters day in and day out, create an illusion of public sentiment that is very difficult to ignore. Thus, the antivivisectionists won in the states of Illi-



FIVE GASES IN FOUR MINUTES WITH FISHER'S NEW GAS PARTITIONER

—carbon dioxide, oxygen, nitrogen, methane, carbon monoxide. Speed and sensitivity of new Gas Partitioner mean many extra analyses daily. One lab is making 80 a day. Columns can be changed for analyses of various gaseous mixtures. Two advances improve reproducibility: A constant-current supply replaces batteries, gives currents of 5 ± 0.25 or 7 ± 0.25 milliamps directly from any 105-130 volt 50/60 cycle a-c line; built-in gas-sampling valve lets you take reproducible samples directly from gas streams in pilot plant or mill, reproduce peak heights within $\pm 1\%$. Full facts in free Bulletin FS-275. Call your Fisher branch or write Fisher Scientific Company, 139 Fisher Building, Pittsburgh 19, Pa.

J-228



FISHER SCIENTIFIC

World's Largest Manufacturer-Distributor of Laboratory Appliances & Reagent Chemicals

Boston • Chicago • Fort Worth • Houston • New York • Odessa, Tex. • Philadelphia
 Pittsburgh • St. Louis • Union, N. J. • Washington • Edmonton • Montreal • Toronto