desiring to improve the visual field of the gastroscope wanted models of gastroscopes from its inception to the present. Television studios needed many kinds of medical aids to illustrate their programs.

Appreciating the need, a group of medical people under the leadership of David J. Davis, Tom Jones, Thomas G. Hull, A. J. Carlson, Morris Fishbein, Haven Emerson, Burrell Rawlston, Chevalier Jackson, Hobart Reimann, and Raymond Allen organized a movement in 1950 to create interest in setting up a Medical Audio-Visual Center to serve the needs of the country. It proposed to extend the splendid work of the museum of the Armed Forces Institute of Pathology and make materials and exhibits available by loan for the purpose of study, teaching, and research. These materials include graphs, charts, EKG's, electroencephalograms, kinematograms, slides (both gross and microscopic), bacteriologic cultures, anatomic and pathological specimens, x-ray films, drawings, maps, photos, autographs, coins, transparencies, models in every medium, dioramas, panoramas, statuary, stamps, instruments (both surgical and medical), drugs, and relics.

The best of the exhibits presented at medical meetings would be preserved and whenever possible loaned, instead of being dismantled and discarded, as happens today. Much of the material is at hand, but the administrative machinery to put them to use is lacking.

A noble encyclopedic project like this, though of breath-taking scope, can be attained with the unselfish cooperation of medical organizations. The success of the Midwest Inter-Library Center in Chicago, which receives literature from, and loans to, twelve different universities which support it, is an example of cooperative achievement.

Such an institution proposes, in addition, to secure, preserve, and exhibit historical items, to perpetuate and make known the best of medical culture and ethics, and to deny these items from reaching the refuse heap, cellar, garret, or rotting in private collections, or from being pawned off by private collectors. Encouraged through the exchange of valuable paintings by art museums, it proposes to make available to medical schools and medical societies the precious manuscript of the Edwin Smith surgical papyrus now treasured by the Library of the New York Academy of Medicine, the original inhaler of William Morton encased in the ether dome at Massachusetts General Hospital, or the instruments that William Beaumont used on the gastric fistula of Alexis St. Martin, now on display at the University of Chicago Medical Library, and of the numerous memorabilia of which each center is proud. It is interested in establishing an agency to ferret out medical treasurers of all kinds. What has happened to the hearts from which Dr. James B. Herrick made his discovery of myocardial infarction in 1912? Where are the original rubber gloves invented by William S. Halsted in 1890?

The creation of a centralized audio-visual agency supported by the medical organizations of the country will have a profound effect upon the dissemination of medical knowledge, modern and historic, and will stimulate research teaching and medical culture. A rich field welcomes the industrious.

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Pain—Controlled and Uncontrolled

"THINKING in pairs" is an old intellectual pastime. Dichotomies are set up between experimental methods (see Beecher, SCIENCE, 116, 157 [1952] versus Hardy, Wolff and Goodell, *J. Clin. Invest.*, 27, 380 [1948]) and read into results by the observers themselves. Objections against dichotomies create new ones, or simply substitute terms, e.g., *physiological* for *experimental* ([Ravich, SCIENCE, 118, 144 [1953]). All these cleavages cut across each other and in the end the pattern becomes impossible to disentangle. Dichotomies serve a certain purpose within a limited context but befog the minds of those who inflate them into becoming all-embracing issues.

Pain produced in the laboratory has some, but not all, aspects in common with pain produced by disease. It has some common aspects in animals and in man. In some other, but not in all, respects these various pains obviously differ, as does to a certain extent each moment of pain from the next in each suffering organism. All pain has physiological aspects, as well as such aspects as are anatomical, pathological, and zoological: you rarely find but what you look for. Pain is a biological phenomenon, but even the historian, the sociologist, anthropologist, logician, poet, or others may have something useful to say about it. An interesting and valid dichotomy could, for instance, be made between "scientific" and "lay" pain, or between "potential pain" which may be beneficial and "actual pain" which is not.

The Hardy-Wolff-Goodell team are criticized by Beecher (SCIENCE, 116, 157 [1952]) for studying contrived pain. Beecher points to the difference between this healthy pain and sick pain, between the emotional setting of the weary, suffering patient and the keen, comfortable subject in the laboratory. The Cornell team (SCIENCE, 117, 164 [1953]) grants the point but says rightly that it is not fundamental. Beecher says that it is. However, he adheres to the sensation-reaction dichotomy of the Cornell team. He even uses it as an argument against the validity of contrived pain research. Ravich, finally, distinguishes the "sensorial sensations" of contrived or physiological pain from, should we say, the "senseless sensations" of pathological pain.

It seems that not the artificiality of contrived pain is so much to be deplored as the artificiality of dichotomizing. While there is some difference between the suffering of ordinary mortals and the measured introspections (guessing at the stimulus rather than the sensation) by Hardy, Wolff, and Goodell and their trainees, a rigid dichotomy between sensation and reaction is at least as artificial as that between contrived

and uncontrived pain. The dolorimetrist cannot distinguish between stimulation and injury; all he does is register degrees.

Splitting the pain experience into "specific" components has not had a convincing demonstration. It is, moreover, doubtful whether on biological grounds the separation of perception, or sensation, from response is desirable. It probably was unhelpful of Hardy, Wolff, and Goodell to pit subjective perception as a constant against objective reaction as a variable: to warm up the old epistemological issue between feeling and observation, not to solve but to confuse it even more. Attacked on theoretical grounds, the dolorimetrists concede only that resynthesis may be "difficult," but maintain in favor of their theory that "the practical importance to the physician in controlling the various aspects of the pain experience is unquestioned." Nevertheless, one cannot help asking the practitioner what he has learned from the dolorimeter toward a more enlightened use or understanding of analgesics, narcotics, sedatives, and placebos.

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Estimation of Gene Frequencies from MNS Data

THE increasing use of blood group data in anthropology is shown by many recent publications (*1–4*). Next to the Rh system of genes, the MNS system is probably the most useful. In order to make use of all the information contained in each set of data, it is desirable to estimate the gene frequencies by an efficient method. A simple method of doing this for MNS data does not seem to have been published.

Maximum likelihood estimates of the gene frequencies are easily obtained as follows. Start with "consistent" estimates of the frequencies of the genes M and N. For a first shot the estimates $m_s = \sqrt{M}$ and $n_s = \sqrt{N}$ may be used, but formulas due to Mourant, which are shortly to be published (*4*), are better.

The total m frequency, which includes the frequency m_s (the frequency of the gene Ms) and m_S (the frequency of the gene MS) can be found by the usual gene-counting method as $m = M + MS + MN/2 + MNS/2$. Similarly $n = N + NS + MN/2 + MNS/2$. Consequently our estimates of the frequencies of MS and NS are $m_S = m - m_s$ and $n_S = n - n_s$.

Using these frequencies, calculate the expected frequencies of the six phenotypes:

$$\begin{aligned} M &= m_s^2 \\ MS &= m_S^2 + 2m_s m_S \\ MN &= 2m_s n_s \\ MNS &= 2(m_s n_S + m_S n_s + m_S n_S) \\ N &= n_s^2 \\ NS &= n_S^2 + 2n_s n_S. \end{aligned}$$

Then calculate the two measures of the degree to which the provisional gene frequencies depart from the maximum likelihood values, from the equations:

$$\partial L/\partial m_s = (2M + MN)/m_s - 2MSm_s/(m_S^2 + 2m_s m_S) - MNSn_s/(m_s n_S + m_S n_s + m_S n_S)$$
$$\partial L/\partial n_s = (2N + MN)/n_s - 2NSn_s/(n_S^2 + 2n_s n_S) - MNSm_s/(m_s n_S + m_S n_s + m_S n_S),$$

where m_s, m_S, n_s, and n_S are the provisional gene frequencies, and M, MS, etc., are the observed numbers of individuals in the respective classes.

Then calculate three quantities

$$I_m = 4G[1 + (M)/(MS) + (N)/(MN) + (N)/(MNS)]$$
$$I_n = 4G[1 + (N)/(NS) + (M)/(MN) + (M)/(MNS)]$$
$$I_{mn} = 2G[1 + (MN)/(MNS)]$$

where (M), (MS), etc., represent the expected values as calculated above and G is the total number of individuals tested.

$$\begin{aligned} \text{Let } V_m &= I_n/(I_m I_n - I_{mn}^2) \\ V_n &= I_m/(I_m I_n - I_{mn}^2) \\ W_{mn} &= -I_{mn}/(I_m I_n - I_{mn}^2). \end{aligned}$$
$$\begin{aligned} \text{Then } \delta m_s &= \partial L/\partial m_s (V_m) + \partial L/\partial n_s (W_{mn}) \\ \delta n_s &= \partial L/\partial m_s (W_{mn}) + \partial L/\partial n_s (V_n) \end{aligned}$$

and the adjusted estimates of the gene frequencies are

$$m'_s = m_s + \delta m_s \quad \text{and} \quad m'_S = m - m'_s$$
$$n'_s = n_s + \delta n_s \qquad n'_S = n - n'_s.$$

If the corrections δm_s and δn_s are large, the process can be repeated with the improved estimates, although in general this is not necessary, as one application of the process yields efficient estimates (*5, 6*).

A similar method can be applied to the case of nine phenotypes resulting when an anti-s serum is also used. Calculations for this and other cases, as well as formulas for the variances of the estimates obtained, will be presented elsewhere.

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Erratum. In the abstract of the paper, "The Direct Observation of Hapten-Antibody Equilibria" presented before the National Academy of Sciences, which was published in the Nov. 13th issue of SCIENCE, p. 570, there is an error due to a miscalculation. A value of 5.5 kcal is given for the free energy of formation (per mole) of a hapten-antibody bond. This value should be 7.6 kcal.

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