To attribute to the method of major fractions a simplicity which belongs only to an earlier process is a case of mistaken identity.

All these useless complications about "divisors" and "quotients" and "fractions" are completely done away with in the modern theory which provides a simple and direct test for the settlement of any dispute between two states. The whole story can be set down in a single paragraph as follows.

In theory, every state should be on a parity with every other state in the matter of apportionment. If in an actual case the congressional district in one state is, say, 10 per cent. larger than the congressional district in another state, then the "disparity" between the two states is said to be 10 per cent. *The method of equal proportions distributes the seats among the several states in such a way that any transfer of a seat from any state to any other state will be found to increase, rather than decrease, the disparity between the two states.* In other words, an apportionment made according to the method of equal proportions is one which can not be "improved" by any shift in the assignments.

This is a test which any one can apply to any given apportionment without any knowledge of the technical short-cut process by which the assignments may have been computed. (See the *Transactions* of the American Mathematical Society for January, 1928.) No "constant divisor" or "series of quotients" forms any part of the process.

The objection is sometimes raised that for purposes of measuring the disparity between two states the size of the congressional district is not so important, on constitutional grounds, as the "individual share" in a representative which each inhabitant possesses. This objection is not valid, however, because if the congressional district in one state is 10 per cent. larger than the congressional district in another state, then also the "individual share" in the second state will be 10 per cent. larger than the individual share in the first state, so that the disparity between the two states remains 10 per cent., whichever basis of measurement is adopted. No question of constitutional interpretation is here involved, because either of these two interpretations is satisfied by the method of equal proportions better than by any other method.

The choice of the wrong method may give incorrect representation to a large number of states. In 1920, six states would have been incorrectly represented if 435 members had been apportioned by the method of major fractions. In 1930, if the estimated populations prove to be in error by only 2 or 3 per cent., a case may arise in which 22 states would be incorrectly represented.

The report of the National Academy of Sciences confirms the earlier report of the advisory committee to the director of the census, which concluded that "the method of equal proportions, *consistent as it is with the literal meaning of the words of the constitution,* is logically superior to the method of major fractions." The purely political attempts which have been made to retain the obsolete method of major fractions in current legislation have proved to be a serious menace to the whole reapportionment movement.

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THE RATE OF WORK DONE BY A RICKSHA-COOLIE

A PECULIARITY of the Chinese street scene is a vehicle strange to Europeans, but used in East Asia, the ricksha. To the physiologist the man drawing the ricksha is especially interesting, for the ricksha-coolie is a man trained for one special movement only, fast locomotion.

Two kinds of running can be distinguished: (1) Relatively slow running with 100 double paces in one minute and with a length of step up to 210 cm. The foot is posed in the same manner as in walking. The sole touches the ground completely during a short time before pushing off with that foot. (2) The second kind of running, making possible a quicker locomotion, involves contact only between the toes and ball of the foot and the ground; but this kind of running can not be continued for any long time.

In the ricksha-coolie there is a rolling motion of the foot, which is both directly visible and demonstrable in photographs. It is characteristic of the first kind of running, and corresponds with the length of the step. In order to demonstrate this I marked off in a very busy street a measured distance, and from a window situated not very far from the street I counted the steps taken by ricksha-coolies in covering this distance. This method has the advantage that the observed person is not aware of being observed, and the length of step is that usually employed. Unlike laboratory experiments all movements are unconstrained and show no more than normal power. In my observations the double step was from 130 up to 200 cm long, depending upon the degree of fatigue. According to Weber a step of 210 cm length forms the border beyond which only the toes and ball of the foot touch the ground.

The number of paces in a minute varied between seventy-six and eighty-seven. The velocity of forward movement of the body was from 109 to 162 m in a minute, or from 6,600 to 9,700 m in an hour.

In ordinary running the arms are also moved, each in reverse direction from the homonymous leg. This movement is impossible or at least very limited in the ricksha-coolie, because he puts the forearms on the shafts; but as the ancient Greeks practiced running in an ambling pace, *i.e.*, right arm and right leg forward at the same time, it appears that the movement of running is not hindered by fixing the arms.

In estimating the work done in drawing the ricksha it must be remembered that the ricksha is so constructed that during motion the center of gravity is over the axle. Consequently the coolie need exert no force upwards, but can apply all his power for pulling. This traction on level ground need only overcome the resistance of friction. I have found this resistance to be from 2 to 5 kg for the occupied ricksha, according to the nature of the ground. These figures harmonize with other data for the frictional resistance.

The work done by the ricksha-coolie is consequently the same as if he were drawing a cord over a pulley at the end of which is fastened a weight of from 2 to 5 kg. In effect while traversing one kilometer he lifts a weight of from 2 to 5 kg to a height of a thousand meters and does a quantity of work of from 2,000 to 5,000 kgm. The work done in one minute is from 260 to 650 kgm.

Thus during fast locomotion about one tenth of a horse-power is used for drawing the ricksha. This is the expenditure of energy over and above that which would occur during running at the same pace without drawing the loaded ricksha. The period during which this high velocity can be maintained is only a few minutes at a time. Both the amount of external work per minute and the duration for which it can be maintained are therefore less than that of the Egyptians who lift water from the Nile,[1] while themselves standing still, or that of French navies[2] ascending a ladder. It is much less than that of the oarsmen in a university crew during a boat race.[3] The energy which the coolie can apply to drawing the ricksha is limited by the considerable exertion involved in transporting his own body by running.

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[1] J. S. Haldane and Y. Henderson, "The Rate of Work Done with an Egyptian Shadouf." *Nature*, August 28, 1926.

[2] Jervis Smith, "Dynamometers." (Quoted by Haldane and Henderson (1).)

[3] Y. Henderson and H. W. Haggard, "The Maximum of Human Power." *Am. Jour. of Physiology*, 72: 264, 1925.

CHEMICAL "TESTS"

EVERY profession, trade or branch of knowledge has its use of words and phrases which convey specific meaning which can be accurately and briefly conveyed in no other way. In chemistry the word "test" carries a very specific meaning. When a chemist "tests" a certain material for phosphorus, he wishes to determine if there is any of this element present and expects to obtain only a very general idea of the relative amount of the phosphorus present. He may not be able to say whether there is nearly 5 per cent. or nearly 20 per cent. present in the material "tested." He may "test" a substance to determine the presence or absence of potassium by a simple flame test requiring less than a minute of time. This "test" is *qualitative* and gives only a vague idea of the per cent. of potassium present. If a chemist wishes to determine the per cent. of potassium in a sample he uses an entirely different procedure requiring several hours of time. This latter procedure is not a "test" but is a *quantitative* determination of the amount of potassium present. The material is *analyzed* for potassium.

In research and other publications, in conversations with scientific men and in correspondence one often notices the word "test" used when reference is actually made to a method of analysis to determine quantitatively the amount of a certain element or compound present in a substance. One may incorrectly mention a protein "test" when he actually has reference to a procedure (Kjeldahl method) which will determine the quantity or per cent. of protein (N) present. A test for the presence or absence of protein may be made by simpler methods (Biuret, etc.). Most requests which come to a chemist are actually for an *analysis* of a sample (for protein, for instance) and not for a "test" (for protein). He *analyzes* the sample and makes a determination of the *per cent.* of protein. He does not "test" the sample for protein or run a protein "test."

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ATMOSPHERIC ELECTRICITY DURING SAND STORMS

THE Jornada Range Reserve—near Las Cruces, New Mexico—is an experiment station maintained by the U. S. Forest Service for the purpose of the study of range problems. Since grazing studies are paramount, the station laboratory is not equipped with the instruments used in the measurement of electrical energy. However, the article entitled "Electricity from the Air" which appeared in the News Supplement of SCIENCE of March 30, 1928, brings