of scientific men who were said to have committed suicide in Vienna, the name of Professor Waldemar Denk, head of the second Surgical Clinic of the University of Vienna, was included. Dr. Denk writes "I am very glad to assure you that I am in the best of health and working without any interruption in my hospital."

NOMINATIONS for the Theobald Smith award in the medical sciences should be sent by June 1 to the office of the Permanent Secretary of the American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. The award was established by Eli Lilly and Company, "to recognize demonstrated research in the field of the medical sciences, taking into consideration independence of thought and originality." It consists of the sum of $1,000 and a bronze medal and is made to an investigator who is under thirty-five years of age. Any fellow of the association, except members of the Award Committee, may submit to the Permanent Secretary's office in Washington, D. C., the name of a proposed recipient of the award with full data regarding his personality, training and research work.

THE Union of American Biological Societies has received a grant of $10,000 from the Carnegie Corporation of New York through the Carnegie Foundation for the Advancement of Teaching toward support of the educational program of the union. The Committee on Biological Science Teaching of the union which is in charge of the project consists of Oscar Riddle, *chairman,* E. V. Cowdry, F. L. Fitzpatrick, H. Bentley Glass, Benjamin C. Gruenberg. Dr. D. F. Miller, associate professor of zoology of the Ohio State University, has been given leave of absence for several months and during this period his full-time services have been secured by the committee.

THE American Association of Anatomists celebrated the fiftieth anniversary of its founding at its annual meeting at the University of Pittsburgh, which was held from April 14 to 16 in conjunction with the annual meeting of the American Association of Physical Anthropologists. A special program was presented by past presidents of the society as follows: Dr. Ross G. Harrison, Yale University, "Factors Concerned in the Development of the Ear"; Dr. Robert R. Bensley, University of Chicago, "Plasmosin: An Important Constituent of Protoplasm"; Dr. Clarence M. Jackson, University of Minnesota, "Nature of Abnormally Rapid Increase in Body Weight Following a Period of Growth Suppression"; Dr. Florence R. Sabin (with Dr. Austin L. Joyner), the Rockefeller Institute, "Tuberculous Allergy without Infection"; Dr. George L. Streeter, the Carnegie Institution, Baltimore, "Origin of the Gut Endoderm in Macaque Embryos"; Dr. Charles R. Stockard, Cornell University Medical College, "Structural Disharmony: The Genetic and Developmental Independence of the Upper and Lower Jaws."

UPON the invitation of the Italian Government, the United States, through the State Department, has appointed delegates to the tenth International Congress of Chemistry, to be held in Rome from May 14 to 21. C. C. Concannon, chief of the Chemical Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, has been named chairman. The other delegates are: Edward Bartow, Norman Bekkedahl, M. T. Bogert, H. A. Gardner, Thomas Midgley, Jr., W. A. Noyes, Sr., C. L. Parsons, Alexander Silverman, W. W. Skinner, J. W. Turrentine and E. R. Weidlein. The National Research Council and the National Academy of Sciences, responding to the invitation of the organizing committee of the congress, as their representatives at the thirteenth meeting of the International Union of Chemistry (under the auspices of which the congress meets) have appointed the following councilors: Edward Bartow, vice-president of the International Union of Chemistry, head of the delegates, and M. T. Bogert, Alexander Silverman, James F. Norris, C. L. Parsons and Robert E. Swain. The delegates are: Ross A. Baker, Norman Bekkedahl, H. K. Benson, Gustav Egloff, Colin G. Fink, S. C. Lind, Thomas Midgley, Jr., Arthur Scott and E. R. Weidlein. Alternates are: Emma P. Carr, John V. N. Dorr, J. B. Ekeley, J. C. Hostetter, W. L. Jennings, R. E. Montonna, W. A. Noyes, Jr., Atherton Seidell and J. W. Turrentine.

DISCUSSION

FORCE IN MECHANICS

I WANT to add the following comments to J. W. Campbell's criticism (SCIENCE, November 12, 1937) of W. F. Osgood's "Mechanics":

In connection with the writing of Newton's second law of motion in the form $F = kma$, Professor Campbell says, "Whether or not it is the best way is a matter of taste." It seems to me that more is involved here than a matter of taste—questions of consistency of notation, simplicity of mathematical expressions of physical laws and the significance of the symbol m are involved.

The arguments used for introducing an arbitrary constant into Newton's law are equally valid for writing $A = kwl$ for the area of a rectangle; because the width and the length may be measured in feet, for

example, while the area may be required in acres. To be consistent those who write $F = kma$ should write $A = k\pi r^2$ for the area of a circle, $P = k\frac{W}{t}$ for power, and so on for all geometrical and physical magnitudes. If this procedure were consistently followed, equations of physics would be so overloaded with various sorts of k that KKK would look relatively sane.

Newton's second law is based on the fact that the force applied to a body is proportional to the acceleration produced; it is written $F = ma$. Here m is the constant of proportionality; it is a physical property characteristic of the body. The case is similar to that of Hooke's Law, $F = kl$, where l is the elongation produced by the force F when applied to an elastic body. In this case also the constant of proportionality is a physical property of the body. There is no more reason for writing $F = kma$ than for writing Hooke's law as $F = k'kl$, kinetic energy as $E = \frac{1}{2}kmv^2$, etc.

The term "centrifugal force" has been a stumbling block to the student of mechanics, and a source of confusion to authors of mechanics and physics.[1] Professor Osgood realizes this and, after using the term, makes the following remarks:

> Why, then, the term "centrifugal force"—the force that "flees the centre"? The explanation is a confusion of ideas. If the mass is held in its path by a string fastened to a peg at the centre, O, does not the string tug at O in the direction OP away from the centre and is not this force exerted by the particle in its attempt, or tendency, to fly away from the centre? The answer to the first question is, of course, "Yes." Now one of the standard methods of the sophists is to begin with a question on a non-controversial point, conceded without opposition in their favor, and then to confuse the issue in their second question—"and is not this force exerted by the particle?"
>
> *Matter can not exert force,* for a *force* is a *push* or a *pull,* and matter can neither push nor pull; it is inert. The particle does not pull on the string, the string pulls on the particle. . . .
>
> And now, after all is said and done, comes the rejoinder: "But the particle *did* pull on the string, for otherwise the string would not have pulled on the peg." There is no answer to these people. Some of them are good citizens. They vote the ticket of the party that is responsible for the prosperity of the country; they belong to the only true church; they subscribe to the Red Cross drive—but they have no place in the Temple of Science—they profane it.

I do not qualify as a "good citizen" under any of these criteria; yet I find the rejoinder reasonable. If the string pulls on the particle, but the particle does not pull on the string, then Newton's third law does not hold at the junction of the string and the particle! If matter does not exert force, what does? Are we to understand that the string, which exerts force, is not matter?

The confusion springs from the use of the word *force* to denote the effect as well as the cause of acceleration. A particle has no acceleration when the vector sum of the forces acting on it is zero; yet a particle in uniform circular motion does have an acceleration, although the sum of the centripetal and the "centrifugal" forces is zero. This apparent contradiction is due to applying the term *centrifugal force* to something which is not a force.

It is worth noting here that persons who use the term *centrifugal force* do not use an analogous term—say, *ab-fugal* (away fleeing) *force*—in discussing motion in a straight line. If there is a centrifugal force in circular motion, because the string which connects the particle to the peg is under tension, there must be an *ab-fugal* force when a particle is given an acceleration by pulling at it by means of a string, likewise under tension.

If a centrifugal force is not a force, what is it? As this question is fully discussed in the third edition of my "Analytical Mechanics" (p. 148, *ff*) I will not take space to answer it.

Commenting on the advice to the student to "Isolate the system," Professor Osgood says, "The man who first uttered these words deserves a *monumentum aere.*" The idea underlying these words has great pedagogical value. Professor Osgood deserves credit for emphasizing it. But it seems to me that the choice of these words is unfortunate. The idea can be better expressed in different words. There is no isolated system in nature, and no natural system can be isolated. Instead of, apparently, asking the student to do the impossible, the instructor should encourage the student to recognize the interactions between systems and between bodies in a system. The student should be trained to focus his attention, in a given problem, on one system or on one body, and then to consider the actions to which it is subject.

In order to compare the relative advantage of expressing the same idea in terms of one or the other terminology, let us consider uniform circular motion of a particle. When the student is told to isolate the particle, Newton's first law will flash into his mind and warn him that an isolated particle moves in a straight line without acceleration—not in a circle with acceleration. When he is told to apply the forces which will make the particle move in a circle, he will apply to the particle a force directed towards the center. Then the argument, "But the particle *did* pull on the string," will present itself, and he will put in another force directed away from the center. Thus the student becomes the victim of the use of abstract and ambiguous words. If, on the other hand, he is told to focus his attention on the particle, to see what bodies are acting

[1] *Cf.* Hertz's "Principles of Mechanics," p. 5.

on it and then to represent their actions by force-vectors, neither the mental conflict nor the confusion about the number of forces involved is likely to appear.

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EFFECT ON ROOT FORMATION OF RETREATING CUTTINGS WITH GROWTH SUBSTANCES

RECENT studies on the effect of growth substances on root formation have shown that an initial basal treatment with these substances is effective in inducing roots on many plants which are difficult to root. This initial treatment usually consists of soaking the bases of the cuttings in .01 to .05 per cent. water solutions of these substances for about twenty-four hours. There are, however, many plants, such as grapefruit and the sweet orange, which respond very little or not at all to such an initial treatment. Cuttings of these plants may show some callus formation at the basal cut surface within three to four weeks after the treatment, but initiate no, or very few roots. It has been found, however, that by retreating such cuttings at varying periods after the initial treatment more roots are formed than by an initial treatment only. In an experiment with Hamlin sweet orange cuttings, the untreated lot produced no roots after six weeks in a propagating frame with bottom heat; cuttings initially treated with .02 per cent. indole-3-acetic acid produced one to two roots; and cuttings retreated three weeks after an initial treatment, three to six roots. The data when tested according to student's method show odds of 4,999 to 1 that the difference indicated between initial treating only and retreating is due to the treatment and not to chance variation. Similar results from retreating have been obtained with papaya and Camellia cuttings. Experiments with other plants are now in progress, including avocado and mango, which have not responded to initial treatments with the usual growth substances.

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NEW FOSSIL LOCALITIES IN THE DURHAM TRIASSIC BASIN

T. R. JONES in 1862[1] noted the presence of *Estheria ovata* (Lea) and of ostracoda near Egypt, N. C., in that part of the Deep River Triassic Area now known as the Cumnock Basin. He referred the octracoda, which had been described by Emmons and others as "Cyprides," "Cytheres" and "Bairdias" to the genus *Candona*(?) and erected the species *rogersii*. Prouty in 1928[2] delimited the Durham Triassic Basin as that portion of the Deep River Area lying northeast of Sanford, N. C., and in 1931[3] reported the presence therein of fresh-water crustacea at a single locality approximately three quarters of a mile west of Nelson, N. C. The crustacea, one a phyllopod *Estheria ovata* (Lea), the other a smooth-shelled ostracod belonging to the family Cypridae, occur in a fine, dark-red, micaceous and carbonaceous shale.

During the spring of 1937, two previously unreported fossil localities were discovered within the Durham Basin. One half of a mile west of Lowe's Grove, N. C., on State Highway 54 there occurs a fine, white to brown, yellow-mottled, slightly metamorphosed shale containing *Estheria ovata* (Lea) and smooth-shelled ostracoda of the Cypridae family. One quarter of a mile east of the same village on State Highway 54 there occurs a fine, dark-red, carbonaceous shale containing a similar fauna.

The ostracoda of the Lowe's Grove localities, as well as those of the Nelson locality, seem to represent a single species and should probably be referred to *Candona ? rogersii* Jones.

The Lowe's Grove Beds are certainly equivalent in age to the Nelson Beds. In agreement with Prouty, the writer believes the fossiliferous shales of the Durham Basin can be correlated with the Cumnock Formation of the Cumnock Basin to the south and with similar fossiliferous shales of other Triassic Areas of Eastern North America.

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DISTRIBUTION OF REPRINTS OF PAPERS BY THE LATE BASHFORD DEAN

THERE have come to me for distribution reprints of twenty short papers published by Dr. Dean from 1908 to 1912. These comprise mainly biographies, book reviews and articles on fossil fishes, evolution and a few miscellaneous subjects. If those who are interested will look up titles for these years in Dr. Dean's bibliography in Volume I of the Dean Memorial Volume and will indicate their preferences, I will supply these so far as the articles are available. Failure to send desired reprints will mean that these are not available.

I should like to put these reprints in the hands of students—especially the younger men—to whom they might be of value.

E. W. GUDGER

AMERICAN MUSEUM OF NATURAL HISTORY

[1] T. R. Jones, "A Monograph of the Fossil Estheriae," Paleontological Society of London, 1862, p. 123.

[2] W. F. Prouty, Abstract, *Bull. Geol. Soc. Amer.*, 39: 210–211, 1928.

[3] W. F. Prouty, *Am. Jour. Sci.*, Fifth Series, 21: 126, 487, 1931.