taken a length of time of which we have no means of getting an idea. But after this animal was developed, the origins of the various great types were not serial, but simultaneous. This animal began to be modified in various directions to fit its surroundings, and the result was a rapid divergence of groups. Slight variations in these simple types would cause the descendants of the various lines to separate still further. We can therefore imagine the Silurian times to be somewhat close to the origin of life, and yet not be surprised at the existence of all the greater divisions of the animal kingdom, and many of the smaller ones. We can also understand why it is that the development of most groups since that time has resulted chiefly in the increase of the abundance and diversity of small branches. For the Gastrea, having diverged into several great branches, has itself disappeared as such, and can of course produce no new sub-kingdoms. Development must now take place within the branches, and must confine itself to smaller and smaller particulars as evolution progresses. Modern embryology, therefore, showing as it does the early divergence of the great types, offers to us an explanation both for the highly diversified fauna of the Silurian age, and for the comparatively less importance of the development that has taken place since that time, even though post-Silurian times be recognized as very much longer than pre-Silurian times. And we are finally led to believe that the vertebrates also were much more abundantly represented in this fauna than the scanty remains hitherto discovered would indicate.

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## *POLITICAL SCIENCE IN FRANCE.*

AS M. Donnat well remarks, politics in France have been largely based on sentiment and abstract reasoning rather than on the lessons derived from observation. Frenchmen are confessedly adepts in constitution-building, but so little acquainted are they with the practical history of political methods that they have not yet arrived at the stage of regarding politics as an art, much less as a science. It is well, therefore, to notice these two works[1] as written in the spirit of comparative politics. M. Donnat maintains that there is a science of politics whose principles are as unvarying and determinate as the laws of the natural and physical sciences. A political solution may be compared to the product of the two gases in fixed volumes to form the molecule of water; nor is there any higher power to introduce uncertainty in the operations of political forces. This is no new thought; and if the English reader wishes to understand the significance of such political inquiry, free, however, from the particular irreligious character of M. Donnat's thinking, he is already in possession of the suggestive work by Sheldon Amos on 'The science of politics.' While the latter has the advantage in philosophic treatment of the subject, the former is more imperative in his claims for the purely scientific nature of politics. He is constantly suggesting parallel illustrations from the other sciences, and derives much comfort from a contemplation of the methods employed by Claude Bernard in his development of the science of medicine. M. Donnat's spirit of inquiry, nevertheless, is admirable, and one sure to be fruitful in its results. He is animated by the spirit which prompted De Tocqueville, Comte, and Le Ploy. Like the first, he has travelled much abroad; and his knowledge of English and American political life extends even to the details of such legislation as our homestead laws. In early life he hoped to find in Comte a guide, but this master soon turned aside, and became a divinity. In Le Ploy, also, he well-nigh found a kindred spirit; but, instead of persisting in those remarkable studies of the civic and industrial institutions of European society, this profound thinker also was drawn into immature synthesis, in declaring that religion was indispensable for private and public life. With M. Donnat it is ever observation and experimentation in politics. The former, on account of the complexity of political phenomena and political Daltonism on the part of the observer, is insufficient. It must be supplemented with experiment. The great success of the Swiss, English, and Americans has been due to their adoption of this principle. Their legislation is not only of local application, but limited in time; and the different legislative assemblies of England's colonies are compared to so many political laboratories. In France, however, legislation is indiscriminating. The colonies have no local voice. An enactment of the Palais-Bourbon is as far-reaching in its provisions as the limits of the most distant colonial possessions. Nor is legislation of that tentative character which should be the spirit of all genuine scientific inquiry. The author, therefore, earnestly pleads that France cut loose from its hard and fast methods, and make trial of local and temporary legislation.

M. Guyot is even savage in his criticisms. The arraignment of French colonial policy is exhaustive in its details. The budgets and commercial statistics of colony after colony are taken up and

[1] *La politique experimentale.* Par LEON DONNAT. Paris, *Reinwald*, 1885.

*Lettres sur la politique coloniale.* By YVES GUYOT. Paris, *Reinwald*, 1885.

skilfully analyzed to prove that no Europeans, except possibly Spaniards or Portuguese, can be acclimated in the zone lying between the isotherms twenty-five degrees north and south of the equator. Of the French colonies, Algiers and New Caledonia are the only ones not situated within these limits. From every point of view, the French colonial policy is shown to be disastrous. Neither the French race or language can thus hope for expansion. Even commercially it is a failure, for foreign nations can undersell France in her own colonies. French emigration is always fatal when it is perpendicular instead of parallel; and there can be no national advance until an intensive colonial culture be substituted for the extensive system so popular in this day. The work has many interesting points for the ethnologist to consider, such as the relations of European colonists with indigenous races. It is written with much force and even grim humor, as when the author, after analyzing the statistical situation of Algiers, sums it up with the picture of the twenty-five thousand productive colonists, each seated on four graves, and guarded by a brace of soldiers.

These two books are suggestive not only for their political philosophy of freedom, but also as furnishing clear and forcible views of the difficulties which stand in the way of French progress.

## *STARS IN RAPID MOTION.*

THE small value of the parallax of 40 $o^2$ Eridani (*Science*, vi. 358), combined with its large proper-motion (4″.10), brings it into prominence as the third or fourth of the stars, moving rapidly across our line of sight. Since a list of these stars seldom appears in works on popular astronomy, we give below the proper-motions $\mu$, the parallaxes $\pi$, and the resulting velocities $v$, in miles per second across our line of sight, of the eight stars which head the list in the order of velocities. The method of deriving the velocities is of course very simple. If a star's annual proper-motion equals its parallax, it moves across our line of sight each year a distance equal to the semi-major axis of the earth's orbit. (How much it moves to or from us can only be told by the spectroscope.) Therefore, since this motion increases directly as $\mu$, and inversely as $\pi$, we have for the annual motion across the line of sight —

$$v\,t = a\,\frac{\mu}{\pi},$$

or, calling $a$ 92.5 million miles, and $t$ the number of seconds in a year, we have for the velocity in miles per second —

$$v = 2.93\,\frac{\mu}{\pi}.$$

Of course, the proper-motions below are much more accurately known than the parallaxes, and where the latter are small the values of $v$ are correspondingly uncertain. The authorities for the adopted values of $\pi$ are given in the column following them. In the case of 40 $o^2$ Eridani, we have weighted Gill and Hall 2 and 1 respectively, as the former determination was made under much the more favorable conditions, and rests upon two comparison-stars. The latest values of Hall and Ball for 61 Cygni are practically identical. The probable errors of all the values of $\pi$ are generally less than 0″.02.

| Star's name. | $\mu$ | Parallax. | | $v$ |
|---|---|---|---|---|
| | | $\pi$ | Authority. | |
| Groombridge 1830.... | 7″.05 | 0″.09 | Brünnow ..... | 230 |
| Lacaille 9352..... | 6 .96 | 0 .285 | Gill..... | 71 |
| 40 $o^2$ Eridani ..... | 4 .10 | 0 .185 | Gill and Hall..... | 65 |
| $e$ Eridani ..... | 3 .10 | 0 .14 | Elkin..... | 65 |
| $\epsilon$ Indi..... | 4 .68 | 0 .22 | Gill and Elkin..... | 62 |
| Lalande 21258..... | 4 .40 | 0 .27 | Auwers..... | 43 |
| 61 Cygni ..... | 5 .23 | 0 .48 | Hall and Ball ..... | 28 |
| Lalande 21185..... | 4 .75 | 0 .50 | Winnecke..... | 28 |

The first will be recognized as Newcomb's 'runaway star,' so graphically described in his 'Popular astronomy;' but it will be seen that the others have velocities which are at least comparable with that of Groombridge 1830, and indicate momenta that represent vast amounts of energy. The discovery of huge suns like our own rushing through space with these great velocities is a matter of more than usual interest just now, from the fact that Mr. Denning's claimed discovery of fixed meteor-radiants has raised the question as to the possible existence of broad swiftly flying streams of meteorites in inter-stellar space, moving with velocities entirely beyond the control of our sun, and so broad that it takes the solar system some years to pass through them. (An annual parallax of 1° in a meteor-radiant corresponds to a velocity of over 1,000 miles per second for the meteor-stream.) The idea of such streams moving with such velocities is a startling one, and, if shown to be true, gives a very vivid idea of the forces acting, or which have acted, in stellar space. It seems at first highly improbable that such can be the case, but with the hard facts of Groombridge 1830, and these other swiftly flying suns staring us in the face, the idea is worth considering, at any rate. If these suns are the products of condensation due to central attraction, so that the luminous energy by which they reveal themselves to us was once energy of translation, it is no violent assumption to suppose that some of their constituent parts were once moving with much greater velocities than that of the present whole. In fact, the man who should claim as a