is for the mathematician to say whether such a system can be stable, and therefore whether such a third body is possible. Although this is a problem of many years' standing it has not yet been approached from the mathematical side, so far as I am aware. It seems probable to the speaker that such a system will be found to be unstable, for reasons similar to those that account for the dark divisions in Saturn's rings and for the gaps in the distances of asteroids from the sun, these divisions and gaps corresponding to places where the periods would be simply commensurate to that of one of Saturn's satellites in the one case, and to that of Jupiter in the other. It is worthy of remark that in not a single instance where a third body has been inferred from a commensurate secondary oscillation, has this body been confirmed by a subsequent detection of its spectrum or otherwise. It is true that in Lambda Tauri two oscillations, both of short period, have been detected; but these periods seem to bear no relation to each other.

A mathematical problem connected with binaries, more important than either of the above, has to do with the origin of these systems. This is one of the few problems in sidereal astronomy with which the mathematician has concerned himself to any great extent, but it is still far from being in a satisfactory state. The past history of the moon, in a dynamical sense, formed the subject of an exceedingly laborious investigation by George Darwin more than 30 years ago. He concluded that the earth and the moon had once formed a single body and that they had broken away from each other by a kind of fission induced by the rotation of the body on its axis. Tidal friction is now set up; it causes the two bodies to draw away from each other, the month to become longer and the orbit of the moon to become somewhat eccentric. Darwin and others have extended this reasoning to double stars, and here the recent work on spectroscopic binaries seemed to afford a striking confirmation of the theory. It has been found that close binaries almost invariably have circular orbits and that their physical condition, as revealed by their spectra, is of the sort that is generally accepted as indicating youth. Widely separated binaries, on the other hand, are apt to have eccentric orbits and to show signs of old age. Still more recently the mathematical side of the question has been reviewed by Moulton, Jeans, Russell and others. It now appears that Darwin's results are at least incomplete and that the causes he adduces are not sufficient to account for the genesis of the moon or for that of double stars. The chief difficulty is that tidal friction is not competent to drive apart to any great distance two bodies of comparable mass that have separated by fission. It appears probable in this view that the separation must have occurred long before the bodies formed stars, that is, while they were still nebulæ. The difficulties of reconciling certain observational facts with this view are great, but it would be out of place to recount them here.

We see that binary systems offer a rich field for the labors of the mathematician. Other subjects in astronomy are equally inviting, and I have no doubt that other sciences have as much to offer. An eminent psychologist, for example, has said that the time has come for a great mathematician to concern himself with psychological problems. There is a proverb to the effect that to him that is well shod the whole earth is covered with leather. And so the mathematician may walk where he pleases. What particular path he chooses is not a matter of great importance, but it is important that he be abroad and doing, and that he do not sit at home admiring his shoes.

Science has often been likened to a warfare, and such a simile as this naturally recurs to the mind at this time. We may think of science as at first occupying a small domain surrounded by the vast territories of the unknown. In the early days it was easier than now to add to this domain. A single bold spirit, starting out in almost any direction, could often wrest much from the adversary. But as the domain of science increases, so also do the extent and diversity of its boundaries. The more obvious points of vantage are already taken and the character of the warfare must change. The day of guerilla warfare is gone, it is now necessary to act in larger groups and for each man to be willing to serve at the side of others. This policy often requires the suppression of personal ambition, and deeds of individual heroism become less frequent; but great victories are to be won in either kind of warfare only if the soldier is imbued with such a spirit as this.

Kinds of Coal Produced in the United States

THE statistics for 1913 show that in addition to the 81,718,860 long tons (91,524,922 short tons) of anthracite produced in Pennsylvania, 35,416 short tons of this grade of coal were mined in Colorado and 34,345 tons in New Mexico. The principal production of semi-anthracite is from Arkansas, with smaller quantities from Oklahoma, Colorado, and Virginia. The production of Sullivan County, Pennsylvania, is included with the anthracite production of that State, though its classification as anthracite is a matter of some contention. This item amounts to about 600,000 short tons annually. West Virginia leads in the production of semibituminous coal, with Pennsylvania second, Maryland third, and Colorado fourth. West Virginia also leads in the production of split coal, and Kentucky is the only other State credited with any of this product in 1913. Cannel coal was reported from seven States in 1913, Kentucky contributing nearly two-thirds of the total. Kentucky also took first place in the production of block coal in 1913, displacing Indiana. These two States yielded over 90 per cent of the total production of block coal. Wyoming is the principal producer of subbituminous coal ("black lignite"), 60 per cent of the State's total being of that grade, and Colorado ranks second, with Montana third and New Mexico fourth. All of the output of North Dakota and nearly half of that for Texas is lignite or brown coal. Bituminous coal is produced in every State having a production of 100,000 tons or more, with the exception of North Dakota.—*Mineral Resources of the United States for 1913, Department of Interior.*

World's Shipbuilding.

IT was not to be expected that the record in shipbuilding established in 1913, both at home and abroad, would be equaled last year. The annual return compiled by Lloyd's Register shows that in the United Kingdom the output of merchant vessels declined by 248,600 tons, while the figures for all foreign countries (which are, however, necessarily incomplete) show an apparent decrease of 231,000 tons.

That Britain's great lead in ship construction was easily maintained will be seen from the following table, giving particulars of last year's production at home and abroad:

	United Kingdom.		Other Countries.	
	No.	Tonnage.	No.	Tonnage.
Steamers	621	1,674,358	473	1,111,027
Sailing ships	35	9,195	190	58,173
Totals	656	1,683,553	663	1,169,200

Of Britain's total output over 75 per cent, or 1,273,530 tons, was built for registration in the United Kingdom. The amount of tonnage launched for other countries was 410,023, forming 24⅓ per cent of the total output, as compared with over 21½ per cent in 1913 and nearly 24 per cent in 1912. Tonnage intended for the British Colonies amounted to 36,736. Of other countries, Holland provided the largest amount of work for the shipbuilders of the United Kingdom, namely, fifteen vessels of 88,097 tons (nearly 5¼ per cent of the total output). Norway occupied the second position with 67,827 tons, being followed by Greece with 41,543 tons, and Belgium with 35,951 tons.

Steamers continue to increase in size. Excluding vessels of less than 500 tons, the average of the remaining steamers reached 4,460 tons gross, a considerable advance on the averages of the five preceding years. Seventy-one vessels of 6,000 tons and above were launched. Of these, thirteen were over 10,000 tons each, the largest being the White Star liner "Britannic," of 47,500 tons; the Holland-Amerika liner "Statendam," of 32,500 tons; and the "Belgenland," of 26,500 tons.

Among shipbuilding centers the Clyde district occupied the first place, showing an output of 444,621 tons (Glasgow 288,103 tons and Greenock 196,518 tons). Then follow the Tyne (315,585 tons), the Wear (277,528 tons), Belfast (239,819 tons), Middlesbrough (137,165 tons), and Hartlepool (124,419 tons).

At the end of December there were under construction, including a number of vessels already launched but not completed, fifty-seven vessels of between 6,000 and 10,000 tons, seven of between 10,000 and 15,000 tons, ten of between 15,000 and 20,000 tons, four of between 20,000 and 40,000 tons, and one of 47,500 tons.

Germany heads the list of foreign countries with an output of 387,194 tons, followed by the United States with 200,762 tons, Holland with 118,153 tons, and France with 114,052 tons. Germany's production shows an apparent decrease of 78,000 tons. Twenty-eight steamers of between 5,000 tons and 10,000 tons were launched in that country during the year, and six of over 10,000 tons. The largest was the Hamburg-Amerikan turbine liner "Bismarck," of about 56,000 tons gross, launched at Hamburg, one of the two biggest vessels now afloat.—*The London Daily Telegraph.*

Salts Colored by Cathode Rays

IN a paper read before the British Association, in Australia, E. Goldstein states that it has long been known that salts bombarded by cathode rays become discolored. This was ascribed by Giesel to partial decomposition of the salt, resulting in the reduction of some of the metal. But the present author found this discoloration may occur in the absence of all metals and in inorganic compounds containing chlorine, bromine, etc. It is here suggested that there is no real reduction, but that the compounds are *distended*, i. e., that the bands between them are loosened. In this distended condition, common to all the elements, matter has a high absorptive power for light. The colors are producible by a very short exposure to cathode or β-rays or to ultra-violet light, to which last agency the real effect is here ascribed. A connection appears to exist between these phenomena and the therapeutic effect of radium and mesothorium in the treatment of skin and other diseases.

SCIENTIFIC AMERICAN SUPPLEMENT

Founded 1876

NEW YORK, SATURDAY, JULY 10th, 1915

Published weekly by Munn & Company, Incorporated

Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer
all at 233 Broadway, New York

Entered at Post Office of New York, N. Y., as Second Class Matter

The Scientific American Publications

Scientific American Supplement (established 1876) per year $5.00
Scientific American (established 1845) . . . . " 3.00
American Homes and Gardens . . . . . " 3.00

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application

Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 233 Broadway, New York

The purpose of the Supplement is to publish the more important announcements of distinguished technologists, to digest significant articles that appear in European publications, and altogether to reflect the most advanced thought in science and industry throughout the world.

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