spection party stationed themselves on either side of a fill with the level of their eyes at the road grade, and a three-fourths-inch rope was stretched across the grade. As the cars hit the rope, the rear wheels were set into vibrations which continued for some distance, and each time the wheels hit the road grade they were observed to throw small amounts of gravel. Within a short time a beautiful set of washboards extended away from the rope but on the approach side little or no corrugations were observed. It might be added that in two weeks' time the road was so badly washboarded that it was necessary to put on a grading crew to resurface the road.

In this semiarid country, the driver's chief object is to get over the road just as quickly as the uniformed motorcycle patrol will allow him. Washboards will develop. It is hoped that road oil, used to reduce the dust menace, will alleviate the damage somewhat. Even the widely praised black-top or bithulitic pavements washboard in hot weather. It appears that the solution is to be found in either leaving the car at home, or in paving with concrete.

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FOLLOWING the discussion and correspondence on the "Washboarding" or corduroy effect on roads traveled by automobiles by L. E. Dodd and Christian A. Ruckmick in the issues of September 2 and November 18, I have a version to contribute. Mr. Dodd's physics is beyond dispute, but my addition is to the road scraper theory. I have seen this sort of ripple on tar and macadam roads. Scrapers are not used on the surfaces of these, although they may be used in leveling the work before the hard surface is put on, and any initial roughness may be imparted up to the surface. Again, in leveling off the surface of macadam a straight edge board is often used, a man on each end pushing it along, but any waviness here would be very minute.

Last summer I was returning by motor from a trip into the Province of Quebec. All the crushed rock and gravel surface roads between the St. Lawrence River and the New England line are very "washboardy." Canada has some very good roads and some very poor ones, concrete and macadam in proportion to the size of the country with the United States, but in this eastern township's part of Quebec the main route north from New England is not yet all hard surface across the line, although roads are very good. You see a great many more horses belonging to the farmers, perhaps one Ford to each farm and a lot of auto tourist cars.

Having crossed back down into Vermont where the macadam began again, I was driving along, when there turned into the highway ahead of me a team of horses drawing a load of hay. It was a warm day, and as is the case when macadam becomes soft with the heat of the day, the heels of a man's shoe or the shoes on the horses sank into the tar slightly, leaving a small mark or hole. A team of horses, walking along a road as I could watch these walking, leave their hoof prints at regular spaces. As I drove along behind, before passing, I noticed how evenly, and, as near as I could judge by eye, this spacing was the same as the wave-lengths of the washboarding. After a team has gone along like this, the automobiles, coming along afterward, will pick up the little loose bits of tar dug up by the calks of the shoes, and by the friction, suction and so forth of the tire treads, hollow out the depression more and more.

The large number of these roads in Canada, as it may be in the West, corresponded, I thought, with the greater number of horses still there. I should say there were fifty per cent. more horses than in New England and New York, where farming is in many places on the decline.

The reason why the concrete roads do not washboard is because they have too hard a surface for the horses' iron to indent. Because, even though the concrete is so much harder, if there were any initial unsmoothness in the construction, either in using a scraper in the leveling of the bed above the subbase or in smoothing off the newly poured cement, in time, heavy automobile or truck tires would cause this effect. Often you do see a certain slight roughness in a concrete road (I mean aside from the cracking), which has come there by the hand smoothing of the men pushing the smoothing board over it, and a slight vibration results, but this never enlarges to the common washboard size.

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A NOTE ON OVARIAN SECRETION AND CANCER

IN an article published in the issue of SCIENCE, for December 16, 1927, I gave a short preliminary report of work done upon the effect of ovarian secretions on the incidence of mammary cancer in a stock of dilute brown mice. One of the primary objects of the paper was to report the successful feminization of castrated males, by means of ovarian transplants, to the extent that they developed, spontaneously, mammary tumors; a thing which thousands of unoperated male mice of this stock have not done.

In SCIENCE of January 27, 1928, Dr. Leo Loeb calls me to task for not quoting him exhaustively in my bibliography and lists two "extensive" reports of his which I did not mention, thus creating in his opinion,

an "erroneous impression as to the development of our knowledge of this problem."

In a brief report such as mine, it is obvious that an extended bibliography would have been out of place. It seemed, moreover, advisable not to make any further reference to Dr. Loeb's work because of the following facts:

(a) The mixed stocks used in his experiments were raised outside of his own laboratory and their ages were only approximately recorded, while the mice which I used have been inbred brother to sister under constant observation since 1909, the exact date of birth of each animal being recorded.

(b) Loeb's youngest class of spayed animals was three to six months old at castration; they may or may not have been bred previous to this. He makes no statement regarding this point, whereas my female mice were all castrated within the 28 to 35-day period and were virgins.

(c) In his total of 133 castrated animals, 98 were non-tumorous, while 35, or 26.3 per cent., were tumorous. These findings he considers significantly different from his 63 non-breeding animals (virgins), 44 of which were non-tumorous and 19, or 30.1 per cent., of which were tumorous. It seems that should a probable error be applied to these figures, there would be no significant difference between them. This fact is shown more conclusively if the totals for my experiment, shown below, are compared with his, mentioned above.

Virgin females, 207; Cancerous 20, or 9.6 per cent.; Non-cancerous 187.

Spayed females, 210; Cancerous 21, or 10 per cent.; Non-cancerous 189.

This provides clear evidence that his statement "prevention of breeding has some influence on the cancer incidence in mice but to a much less extent than castration" is entirely unconfirmed by experiments more than twice as extensive as were his.

(d) In that part of his experiment in which he attempted to "feminize" castrated males by implanting ovaries, he used a grand total of 19 animals, none of which developed mammary tumors.

In my experiment 210 animals were used for operation and four developed mammary tumors.[1]

This in turn provides clear evidence that his conclusion that the "transplanted ovaries are probably not able to call forth rhythmic growth changes in the mammary gland . . . and consequently cancer is not induced in such animals as the result of the experimental procedure" is totally contrary to the fact obtained in a series more than ten times as extensive as his own.

Without the positive evidence that it is possible to cause mammary tumors by transplanting ovaries to the bodies of castrated males, the statement that ovarian hormones are one of the factors in the etiology of mammary cancer seems to lack final confirmation. Such proof was not provided by Loeb's work.

In view of these facts, it still seems that it would have been better had Dr. Loeb not forced a consideration of the earlier papers to which he referred.

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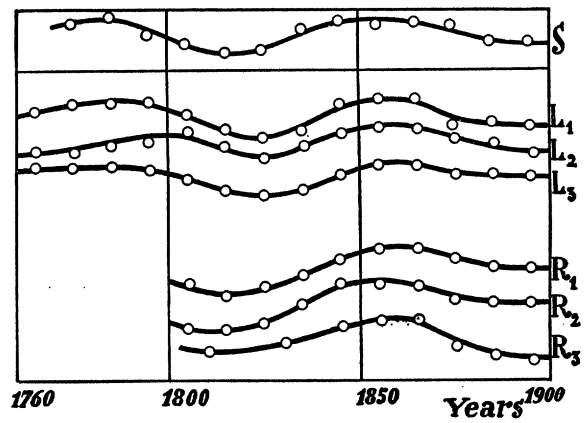
[1] Since my paper was published, seven additional males in this experiment have developed mammary tumors and many of the animals are yet alive.

ON A RELATION OF THE SUN'S ACTIVITY TO SOME BIOLOGICAL FACTORS

THE relation between the activity of the sun and different physical and biological factors on the earth can be illustrated by the following curves. The curve S gives the number of sun spots as a measure of the sun's activity (*Wolf*). Curve L_1 gives the relative



numbers of births, L_2—deaths and L_3—marriages for Leningrad and the curves R_1, R_2, R_3 give the same numbers for all the territory of Russia. In all cases there are given *means for ten years*. It would be of interest to find the same relations for other countries.

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THE SHARP RATTLING IN STEAM-PIPES

WHEN the water in a cryophorus is at a temperature somewhat above freezing, it is possible to trap bubbles of water vapor in the liquid column by holding the cryophorus horizontally. Under the proper conditions of pressure due to motion of the liquid column, the bubble of water vapor will *suddenly* condense, causing the water surfaces of the bubble to come together with a sharp click.