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— 1938 —

The Saranac Laboratory for the Study of Tuberculosis

OF THE EDWARD L. TRUDEAU FOUNDATION

REPORT OF THE DIRECTOR

AND

FINANCIAL REPORT

FOR THE YEAR ENDING SEPTEMBER 30, 1938

REPRINTS OF SCIENTIFIC PAPERS

The Saranac Lake Academy of Medicine

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THE SARANAC LABORATORY

THE fact that the Saranac Laboratory has always been a separate institution from the Research and Clinical Laboratory of the Trudeau Sanatorium is not generally understood. Both Laboratories are sponsored by the Trudeau Foundation, but the Saranac Laboratory is located at 7 Church Street in the village of Saranac Lake and not at the Sanatorium.

The properties of the Saranac Laboratory consist of the original building, given to Dr. E. L. Trudeau by Mr. George C. Cooper in 1894 as a private research laboratory, together with the John Black wing, donated by Mr. and Mrs. Frank B. Black in memory of their son. The addition contains the library and lecture room, erected in 1927 and 1928, and private research rooms constructed in 1931. There are also two animal houses.

To avoid confusion, the Trudeau Foundation publishes separate reports of the Trudeau Sanatorium and the Saranac Laboratory.

THE SARANAC LAKE ACADEMY OF MEDICINE

IN July, 1931, a group of physicians in Saranac Lake met in the John Black Room to discuss ways and means for supporting the diagnostic and research activities in the Saranac Laboratory during a period of diminishing income. They were of the unanimous opinion that this institution is essential to the continued existence of the village as a center for the scientific treatment and study of tuberculosis. As a concrete expression of this feeling, they constituted themselves the nucleus of a body to be known as the Saranac Lake Academy of Medicine. Its object is "to foster interest in the pursuit of scientific medicine in Saranac Lake" through the agency of the Saranac Laboratory. Its members pledge themselves to support the activities of this institution in every possible way and to seek assistance from others for its operation. The active members are physicians practicing in Saranac Lake, but associate, sustaining, and life memberships are also open to interested laymen. In the financial report for the current year will be found a list of the contributors.

The formation of the Academy created nothing new. The Laboratory, the Library, the diagnostic service, the scientific lectures and research have always been an integral part of the medical life of Saranac Lake, but by many they have been freely accepted as a natural heritage from the great founder of this health community. By membership in the Academy of Medicine, or by contributions through it, anyone can feel that he has a part in keeping alive the Trudeau ideals for the furtherance of medical science.

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1938

THE SARANAC LABORATORY

TRUSTEES

LEROY U. GARDNER, M.D., *Director*

EDWARD R. BALDWIN, M.D. — WILLIAM S. THOMPSON, M.D.

OLIVER B. JAMES, *Treasurer* — ROY DAYTON, *Secretary*

DONALD E. CUMMINGS, B.S.

Assistant Director in Charge of Field Work

00557

1938

THE SARANAC LABORATORY FOR THE STUDY OF TUBERCULOSIS OF THE EDWARD L. TRUDEAU FOUNDATION

LABORATORY STAFF

Leroy U. Gardner, M.D. ..... Director
Arthur J. Vorwald, Ph.D., M.D. ..... Pathologist
Thomas M. Durkan, M.E. ..... Chemist and Engineer
Louis Berkelhamer, B.S., M.S. ..... Petrographer
Douglas S. McCrum, B.S. (E.E.) ..... Photographer and Assistant Engineer
Morris Dworski, B.S., C.P.H. ..... Clinical Bacteriologist and Assistant in Experimental Pathology
Catherine M. Cummings ..... Librarian and Secretary
Roy Dayton ..... Financial Secretary
James V. Luttrell ..... Purchasing Agent and Technician
George C. Hulpritt ..... Technician
Anthony B. Delahant ..... Technician
John C. Schmidt ..... Clinical Laboratorian
Andrew J. Redlin ..... Technician
Francis T. Creedon ..... Technician
Edward Gockler ..... Technician
Roy A. Grinnell ..... Technician
Louis A. Bauden, B.S., M.A. ..... Fellow in Chemistry
Robert Banker ..... Assistant
Henry C. Stout ..... Assistant

FIELD AND CONSULTING STAFF

Donald E. Cummings, B.S. ..... Assistant Director in Charge of Field Work
Homer L. Sampson, D.Sc. ..... Consulting Roentgenologist
Daniel M. Brumfiel, M.D. ..... Clinical Consultant
Robert N. Downs ..... Roentgenological Supervisor
Richard Libby ..... Roentgenological Technician
Richard Walters ..... Roentgenological Technician
Joseph Goldstein ..... Roentgenological Technician
Melvin Berg ..... Bacteriological Technician and Clerk
Helen R. Smith ..... Stenographer

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1938

CONTENTS

Report of the Director

Financial Statement

Reprints of Scientific Papers

ARTHUR J. VORWALD

Dust and Pulmonary Disease

ARTHUR J. VORWALD and JOHN W. KARR

Pneumoconiosis and Pulmonary Carcinoma

ARTHUR J. VORWALD and ANTHONY B. DELAHANT

The Influence of Silica on the Natural and Acquired Resistance to the Tubercle Bacillus

DONALD E. CUMMINGS

Suggestions for the Control of Silicosis in Mining

LEROY U. GARDNER

Reaction of the Living Body to Different Types of Mineral Dusts with and without Complicating Infection

Etiology of Pneumoconiosis

Evidences of Inhibitory Action of Different Minerals upon Silica

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purpose of this pg. is merely to indicate end of preceding pgs.

REPORT OF THE DIRECTOR
of the Saranac Laboratory for the Study of Tuberculosis
1938

LEROY U. GARDNER, M.D.

THE year just completed has been unusually busy owing to increasing demands for service from industry; not only the field staff, but members of the research group in the laboratory have been devoting a large amount of time to collection and analysis of data from industrial plants. While this has provided much needed income to carry on investigative work it has imposed heavy burdens on the research staff. Many of them are working longer hours in order that the research shall not suffer. The Field Director's services have been in such demand that he is dividing his time between widely scattered plants. While industrial contacts are essential to research, the tendency to devote too much time to producing income must not be permitted to encroach upon the essential function of the institution.

Research Laboratory

As heretofore the problems under investigation naturally fall into two categories, the effects of different dusts alone and their influence upon associated tuberculous infections. Some of the more interesting experimental results are summarized briefly without technical details.

More evidence is gradually accumulating which suggests that silica (quartz) is a poison and that particles of this mineral have unique effects upon living tissues. If enough very fine particles of quartz are injected into the blood stream of animals, symptoms of shock promptly develop and death occurs within a half hour. The same quantity of the same sized particles of other minerals has no such effect. The fatal dose of quartz particles is rather sharply defined. A tolerance is acquired by repeating the injections so that in time an animal will stand several times the originally fatal quantity. A variety of substances added to the saline suspension of quartz particles neu-

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REPORT OF THE DIRECTOR
of the Saranac Laboratory for the Study of Tuberculosis
1938

LEROY U. GARDNER, M.D.

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tralizes the poisonous action so that the quartz can be injected into the veins without untoward effects. Completion of this series of experiments, which has been in progress for several years, may shed new light on the mode of action of silica on the body.

Further studies on the physical chemistry of suspensions of quartz and silicates in water and various body fluids are in progress. Comparisons are being made between the amount of dissolved silica and the type of reaction elicited upon injecting measured doses of these minerals into experimental animals. These as well as other studies continue to suggest that factors other than solubility may also be responsible for the peculiar irritating properties of free silica.

The action of inhibitor minerals which seem to retard or prevent the development of silicosis is still being investigated. Exposures of animals to atmospheric dusts containing free silica and other minerals demonstrate that silicosis will develop in some but not all of them; provided that exposure is continued for periods three or four times as long as that necessary to cause reaction with a similar quantity of quartz in pure state. Two mechanisms seem to account for the retardation. Physical properties of suspensions of quartz and certain other mineral particles in the atmosphere are responsible for a decrease in the amount of silica inhaled. Physico-chemical reactions with the other minerals may coat the surface of silica particles that have already been inhaled into the lungs and thus reduce the surface areas of irritant in contact with the tissues.

Measurements with a Tyndallometer are affording gratifying confirmation of the atmospheric protective effects with some of the mixed siliceous dusts already studied by other methods. Observations are being continued upon other mixtures to discover whether such behavior is general. Chemical and petrographic analysis of samples of mixed dusts from experimental dust rooms and from industrial plants continue to confirm the thesis that the silica content of atmospheric dust differs from that of the rock from which it is produced and that the composition of settled dust may differ materially from that floating in the air. These matters are of practical importance in the selection of the site of sampling dusts to evaluate silica hazards.

Comparative studies of the effectiveness of different inhibitors reveal that some are more potent than others. Prolonged observation will be required before the results of animal tests can be evaluated.

Another investigation involves the influence of various methods of fracturing rock upon the capacity of the resultant dust to irritate the tissues. New experiments have been designed to discover, if possible, why miners who

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C O D E I S O I O S O

drill and blast certain kinds of rock almost invariably develop silicosis while mill men who crush and grind the same rocks are relatively free from the disease.

The inhalation of high concentrations of very finely ground asbestos fibre has now been continued for approximately two years but the exposed animals still show practically no fibrosis. Since a previous experiment had demonstrated that much lower atmospheric concentrations of unground, long-fibre asbestos would produce appreciable degrees of fibrosis in only 15 months, it would appear that grinding had minimized the irritating properties of this fibrous mineral.

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The grinding had not altered the molecular structure of the asbestos for its x-ray diffraction pattern remained the same. It had not changed the capacity to remain in atmospheric suspension and be inhaled into the lungs because chemical analysis revealed adequate quantities in these organs. It was therefore concluded that the grinding had only altered the size of the asbestos. That decrease in size should produce less reaction was surprising for it had been previously proved that the free silica (quartz, flint, etc.) became more irritating as size decreased, a conclusion which pointed to physico-chemical irritation proportional to the surface of silica in contact with the tissues. In view of all these findings, it was logical to infer that the moderately long but stiff fibres of the unique mineral, asbestos, were *mechanically* irritating to the lungs as they moved in respiration. Continued observations of the inhalation experiments have not altered this view; important confirmatory injection tests into immobilized lungs have not progressed far enough to suggest the outcome.

Investigation of infection associated with pneumoconiosis is more difficult because of variations in individual susceptibility to different bacteria. By the use of large groups of animals and by repeating experiments several times, the average response may be determined. Past experience with animals inhaling pure silica dust has demonstrated a uniform increase in susceptibility to tubercle bacilli of attenuated virulence. Healing foci of infection with such organisms, which in normal guinea pigs would completely resolve and disappear, are reactivated by the inhalation of silica dust and in most animals chronic tuberculosis ensues. Current experiments with dusts composed of silica mixed either with iron or gypsum are demonstrating that this "normal" effect of silica upon tuberculosis is modified by the non-siliceous element in the dusts. At first the response of the tuberculous foci is irregular. In a few of the animals the infection spreads and produces generalized disease; in more of them it seems to have healed with the formation of localized scars at the site

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of the first tubercles. But in practically all that survive still longer the tuberculosis spreads very slowly and gradually involves much of the lung tissue. In some cases the chronic infection continues to be active until death but in others it heals and forms scar tissue whose specific characteristics entirely disappear so that its tuberculous origin would hardly be suspected.

This sequence of events and the forms of the resultant disease correspond very closely with what has been observed in human beings. Only a small proportion of any group of exposed workmen develop tuberculosis and the infections that do develop are generally manifested later in life than in the general population. There are cases of so-called "conglomerate fibrosis" which do not exhibit the characteristic picture of healed tuberculosis but in which this origin has been strongly suspected. There are other cases of "tuberculo-silicosis" in which the tuberculous element is still active and recognizable as such. Since most human beings are exposed to mixtures of silica and other minerals rather than to dusts of pure silica, it would seem that these experiments are reproducing clinical findings.

Work in progress aims to discover, if possible, the conditions which determine whether the healed "conglomerate" type of silicosis or the chronic "tuberculo-silicosis" will develop. However, imponderable factors of hereditary resistance to infection may be involved which will outweigh those of acquired immunity produced by artificial means.

Some surprisingly consistent results have been obtained on infecting silicotic rabbits with different types of pneumococcus. They seem to indicate that such rabbits are at least no more susceptible to this infection than normal ones and that immunity to these organisms is not altered by the co-existant silicosis. The statistical picture of pneumonia in silicotic subjects has not been clearly defined. It is coming to be believed that such persons do not suffer from more lobar pneumonia than the general population, but that the outcome of the cases that do develop in silicotics is apt to be unfavorable. On the other hand, it is thought that bronchopneumonias due to infection with various bacteria may be unduly common and severe in such subjects. The experimental approach may help to clarify this situation.

Field Studies

Under the personal supervision of the Field Director, Mr. Cummings, the investigations of hazards and the supervision of corrective programs have been continued in the foundries of the Colorado Fuel and Iron Company and

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various mines operated by members of the Lake Superior Iron Ore Association in Michigan and Wisconsin. Contact is still maintained with the Inland Steel Company's plant at Indiana Harbor although this is now restricted to consultation, the responsibility for the medical examination and engineering control having been taken over by the company. The medical portion of a complete study of the hazard in an iron mine in New York State recently acquired by the Republic Steel Corporation is well advanced. The engineering study of conditions in the mines and mill will begin shortly with Mr. McCrum, an engineer from the research staff, at least temporarily assigned to the field division.

In addition, two and sometimes three engineers and chemists, Mr. Durkan, Mr. McCrum and Mr. Redlin from the Laboratory group have been working on industrial surveys. They have analysed the materials and determined the character and concentration of dust in twelve stone quarries located in various parts of New York State. They have surveyed conditions in two more cement plants, one located in Iowa and the other in New York. They have tested the efficiency of a new dust removal device installed in a foundry. Chemical and petrographic analysis of materials collected in these surveys and in some of the cement plants the year before, together with the preparation of reports has occupied a large part of their time.

In the steel plants the Field Director has studied not only the hazards due to dust but those associated with sudden changes of temperature, with toxic fumes and with the use of various organic solvents. The usual precautions for the alleviation of hazards have been instituted where possible but generally new methods have had to be devised to meet the special conditions existing in each industry.

In the Lake Superior district he is co-operating with the mining officials and the public health authorities in a campaign to control tuberculosis in the communities. In some of the locations this infection is as serious in the women and children as in the miners. An active program of case finding and hospitalization of persons with open lesions is now in operation. Control of the dust hazards underground and reexamination of the miners still continues as routine practice.

A final summary of the engineering findings in 17 different cement plants and of the physical examination of the 2,178 employees in six of them is being prepared for publication. The conclusions support those drawn after examining only a part of the men, namely, that the inhalation of pure cement dust for periods as long as 40 or 50 years produces little if any demonstrable effect on the lungs. Furthermore, although some of the "raw mills" create

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dusts that may contain from 15 to 40 per cent of free silica, prolonged employment in this department does not result in silicosis. Presumably the the limestones or clays treated at the same time act as inhibitors to the silica. Among all the 2,178 men examined 8 were found with silicosis and of these, 6 obviously developed their disease in previous employment. Of the two cases attributable to exposure in the cement industry, one was a quarry man drilling sandstone and the other was grinding sandstone for a special kind of cement.

Teachings, Addresses and Publications

A most successful session of the Trudeau School of Tuberculosis was held this year in which all members of the Laboratory staff participated either as formal lecturers or as demonstrators. The symposium on silicosis was omitted as it was agreed that not enough data on certain debatable points had been accumulated. Another symposium will be held in June 1939.

Numerous addresses have been made by the different members of the staff before medical and engineering societies. As a member of the Correspondence Committee on Silicosis of the International Labour Office, the Director attended a two weeks session of that body in Geneva, Switzerland.

Dr. Vorwald continues to conduct classes in pathology at Trudeau Sanatorium for the Post-Graduate School of Nursing. He has also given a most instructive series of clinical-pathological lectures on alternate weeks to the Saranac Lake Medical Society.

Clinical Laboratory Work

Under the new plan of distributing the clinical diagnostic work among permanent members of the Laboratory staff it is believed that a more efficient service is being rendered to the physicians. Dr. Vorwald has assumed entire responsibility for this department. He personally performs all autopsies and makes diagnosis on tissues removed at operations. Mr. Dworski is clinical bacteriologist, Mr. Delahant is on call at all hours for pneumococcus typing and Mr. Hulpritt for thirty years has been ably examining specimens of various kinds for tubercle bacilli. Mr. Schmidt, as hematologist and blood chemist has succeeded in making himself an invaluable consultant.

The following table classifies the 1,180 examinations made during the calendar year of 1938.

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Summary of Diagnostic Examinations

January 1, 1938 to December 31, 1938

Diphtheria Cultures	24	Sputum for Tubercle Bacilli	1290
Vincent's Angina, Smears	12	Feces, Smear, Culture and Parasites	122
Pneumonia, Typing (Neufeld)	29	Milk, Bacterial Counts	30
Undulant Fever	8	Water, Bacteriology	62
Enteric Diseases	9	Water, Orthotolidine	365
Gonorrhea, Smears and Culture	20	Urine, routine and special tests	1132
Blood:		Autogenous Vaccines	28
White and Differential	460	Surgical Pathologic Specimens	220
Red and Hemoglobin	345	Autopsies, Human	49
Matching and Typing	255	Referred Autopsy Tissue	8
Cultures	19	Animals Inoculated for diagnosis	49
Chemistry	175	Ascheim Zondek Pregnancy Test	25
Sedimentation	128	Miscellaneous Examinations	692
Spinal Fluid, Urine and other Material for Tubercle Bacilli	64	Total Examinations	5580

The total number of tests performed is 1229 less than in the preceding year. The decrease is entirely due to fewer requests for examinations of a routine character, which are being performed elsewhere in increasing numbers. The physicians tend to call upon the diagnostic staff for the more complicated tests requiring special skill and equipment.

Staff

During the past year Dr. John Karr, assistant roentgenologist at the Sanatorium, resigned to accept a position in another institution. His services of the past two years are gratefully acknowledged.

Mr. Louis Berklehamer, formely of Battell Institute, joined the staff as petrographer in June. His intimate knowledge of his specialty and of physical chemistry are proving extremely valuable. It is no longer necessary to depend upon consultants elsewhere to be assured of the purity of the minerals with which experiments are being made and it is possible to have all the necessary analyses of dusts and minerals encountered in industrial surveys. In collaboration with the chemical department he is studying various physical properties of atmospheric suspensions of mineral particles.

Mr. Louis Brinkus, a research fellow, who has been studying the chemistry

00568

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of collagen in silicosis left the laboratory at the end of the year but will continue his work in a neighboring institution.

The director once again gratefully acknowledges his debt to every member of the laboratory and field staff, who carry the burdens of these manifold activities. He is deeply appreciative of their cheerful co-operation. To Dr. Baldwin, retiring Director of the Trudeau Foundation, he has brought many problems and always found help. Although Dr. Baldwin will lay down his official title of Director with the coming year, it is the sincere hope of every member of the institution that he may continue to guide us for a long time to come.

Finances

The summary of finances that follows indicates current income from various sources of $73,044.34, which is $13,525 in excess of that for 1937. Of this total $40,422.53 was received for consultation service in industry and $25,000.00 as contributions for laboratory research by industrial and insurance groups. Other income includes $1,700.00 of miscellaneous contributions, $5,771.20 from invested endowment and $150.00 from other sources. This, with the balance of $10,989.88 on hand at the beginning of the year made a grand total of $84,034.22 available for current expenses.

Total expenditures amounted to $66,900.20 of which $55,471.85 was paid out in salaries, $10,794.55 for supplies, equipment and operating expenses. An unexpended balance of $17,134.02 remained on hand at the end of the year.

It is the director's privilege to acknowledge his debt to all who have contributed to support of the work. Their names and the amounts of their donations will be found below. Special attention is called to the unrestricted appropriations of $10,000.00 (of which $8,250.00 was paid in during this fiscal year by the Air Hygiene Foundation of America) which has permitted the establishment of the department of petrography, to the $5,000.00 from the National Association of Mutual Casualty Companies, to the $5,000.00 annual appropriation from the Association of Casualty and Surety Executives ($2,500.00 paid in our fiscal year). The Employers Mutuals Insurance Company turned over receipts of $1,237.61 from the sale of copies of the Silicosis Symposium. A few loyal friends still contribute through the Saranac Lake Academy of Medicine to the support of more adequate diagnostic facilities in the community.

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SARANAC LABORATORY FOR THE STUDY OF TUBERCULOSIS

RECEIPTS AND EXPENDITURES

Year ending September 30, 1938

Balance on hand October 1, 1937:		
Cash	$ 9,937.38	
Securities	1,052.50	
		$10,989.88
Receipts:		
From Trudeau Foundation	5,771.20	
*Gifts and other receipts for maintenance of plant and work	67,123.14	
Sale of old equipment	121.00	
Dividends on stock held temporarily	29.00	
Total receipts for the year		73,044.34
Total of balance and receipts		84,034.22
Expenditures:		
For research and field surveys	$5,471.85	
Travel and other expenses of workers	1,004.58	
Permanent equipment	1,606.43	
Fuel, light, animals, feed, supplies and other running expenses	8,184.54	
Total disbursed	66,267.40	
Loss on sale of securities	632.30	
Exchange on foreign cheques	.50	
		66,900.20
Balance on hand September 30, 1938		17,134.02

*See following pages for list of contributors.

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CONTRIBUTIONS

TO THE

SARANAC LABORATORY

From October 1, 1937, to September 30, 1938

(Note: Items received after October 1, 1938, in second column, to be credited in 1939 report)

Adirondack Fund for the Tuberculous	1,000.00	249.99
Air Hygiene Foundation of America	8,250.00	2,500.00
Ass'n of Casualty & Surety Executives	2,500.00	2,500.00
Mrs. Bigelow Crocker	10.00	10.00
Mrs. Charles L. Crocker	50.00	50.00
Mr. Donald E. Cummings	100.00	
Mr. Thomas E. Durkan	105.00	
Dr. Leroy U. Gardner	500.00	
Inland Steel Company	8,333.29	1,229.19
Johns Manville Corporation	5,000.00	1,250.00
Mr. Lawrence Macfarlane	100.00	
Dr. Raymond C. McKay and friends	50.00	
Miscellaneous	1,540.00	2,213.18
National Association of Mutual Casualty Companies	5,000.00	
Oliver Iron Mining Company	1,608.25	
Pickands Mather & Company, for Lake Superior Iron Ore Association	17,818.99	3,750.00
Portland Cement Association	10,417.00	2,344.00
Mr. Arthur B. Purvis	250.00	
Saranac Lake Academy of Medicine:		
Dr. Edward R. Baldwin	50.00	
Mrs. A. C. Erkander	50.00	
Miss A. Louise Gilbert	20.00	
Carried forward	62,752.53	16,096.36

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Brought forward	62,752.53	16,096.36
Mrs. Henry Hudson	35.00	
Dr. David T. Smith	10.00	
Sales of Book "Silicosis Symposium" through Mr. B. E. Kuechle of the Employers Mutuals Insurance Co.	1,237.61	60.00
United States Gypsum Company	3,013.00	40.00
In Memory of Sydney Lunt Wood:		
Miss Sarah C. Armistead	5.00	
Miss Susan Wood	50.00	
Mrs. S. L. Wood & Mr. John Wood	20.00	20.00
	67,123.14	16,216.36

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